

FM 55-21

DEPARTMENT OF THE ARMY FIELD MANUAL

RAIL TRANSPORTATION HIGHER UNITS



DEPARTMENT OF THE ARMY

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RAIL TRANSPORTATION HIGHER UNITS

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PART ONE

INTRODUCTION

CHAPTER 1

PURPOSE AND SCOPE

1. Purpose

The purpose of this manual is to guide commanders and staffs of transportation military railway service higher units. It is also designed to provide basic information for commanders and staffs of military railway service lower units, for commanders of supporting units, and for staff officers of higher headquarters.

2. Scope

a. This manual describes the mission, composition, and employment of military railway service higher units. It also describes military railway planning and operations in a theater of operations.

b. All table of organization and equipment references give only the basic number. The reference will apply to the table with the basic number, and also the tables with the suffixes A, B, or R.

CHAPTER 2

MISSION AND CHARACTERISTICS OF THE TRANSPORTATION MILITARY RAILWAY SERVICE

3. Mission

a. In theaters of operations the mission of the transportation military railway service is to operate and maintain all military railways. The transportation military railway service is utilized to control and supervise the functions of those military railways operated and maintained by civilian personnel in support of military operations.

b. In the continental United States, during periods of peace and mobilization, the transportation military railway service trains personnel and operates and maintains Department of the Army training railways. The general headquarters of the transportation military railway service, a unit of the United States Army Reserve, acts as an executive agent for the Chief of Transportation for liaison with the civilian railway industry. Its purpose is to make competent and qualified railway personnel available to the military.

4. Military Railways

a. Military railways include all railways (standard gage or otherwise) and railway facilities in theaters of operations which are constructed, maintained, or operated in support of United States military operations. Construction, maintenance, or operation may be by military personnel or by civilian personnel under military direction.

b. Military railways also include Department of the Army railways and railway facilities in the United States used for training purposes by the transportation military railway service.

5. Characteristics

a. *Railway Transportation.* Rail transportation is characterized by the ability to move large tonnages of cargo and large numbers of personnel over long distances at a uniform rate of speed. Use of rail transport facilities insures speed and regularity of delivery and involves minimum risk of cargo deterioration by weather. Flexibility is limited by the dependence of the railway upon a fixed

roadbed, the direction assumed by the scheme of maneuver in relationship to the rail route, and vulnerability to enemy action. Railway transportation in a land mass theater is normally the principal means of overland transportation, and the utilization of railway facilities to their fullest extent is a basic principle of sound transportation practice.

b. Transportation Military Railway Service. The transportation military railway service is an operating agency of the theater transportation service. An intersectional service, it operates throughout the communications zone and into the combat zone. It is comprised of Transportation Corps railway supervisory, operating, and maintenance units, as required, to operate trains, to maintain rail lines of communications, and to perform organizational, field, and depot maintenance on locomotives and rolling stock (fig. 1). Transportation military railway service supervisory units are so constituted that, depending upon the extent of the operation, any one of them may perform the staff and planning functions of, and serve as, the highest echelon of the transportation military railway service in a theater.

6. Organization of the Transportation Military Railway Service (fig. 2)

The transportation military railway service is organized into supervisory, operating, and maintenance units as follows:

a. Supervisory.

- (1) General headquarters, transportation military railway service (TOE 55-201R).
- (2) Headquarters and headquarters company transportation railway command (TOE 55-302R).
- (3) Headquarters and headquarters company transportation railway group (TOE 55-202R).

b. Operating.

- (1) Transportation railway operating battalion (TOE 55-225R).
- (2) Augmentation teams (TOE 55-500R).

c. Maintenance.

- (1) Transportation railway shop battalion (TOE 55-235R).
- (2) Railway workshop (mobile) (TOE 55-500R).
- (3) Augmentation teams (TOE 55-500R).

7. Comparison with United States Commercial Railway Organization

a. The overall organization of the transportation military railway service was adopted from, and is similar to, the organization of the operating department of a commercial railway in the United

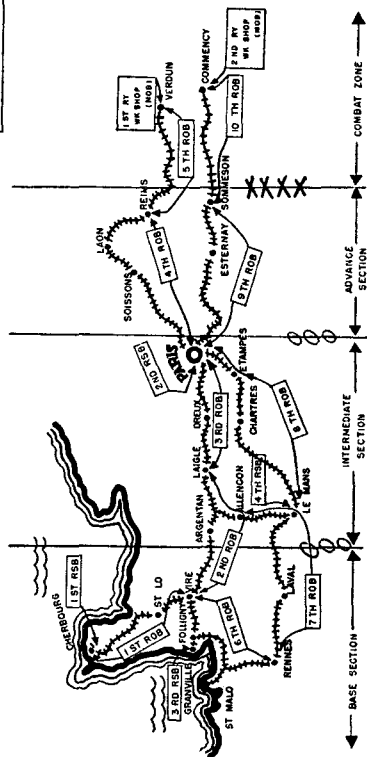
TRANSPORTATION MILITARY RAILWAY SERVICE TROOP LIST
(1ST RAILWAY COMMAND (CONT))

First RAILWAY GROUP

- 1st RAILWAY OPERATING BATTALION
2nd RAILWAY OPERATING BATTALION
3rd RAILWAY OPERATING BATTALION
4th RAILWAY OPERATING BATTALION
5th RAILWAY OPERATING BATTALION
1st RAILWAY SHOP BATTALION
2nd RAILWAY SHOP BATTALION
1st RAILWAY WORKSHOP (MOBILE)

2nd RAILWAY GROUP

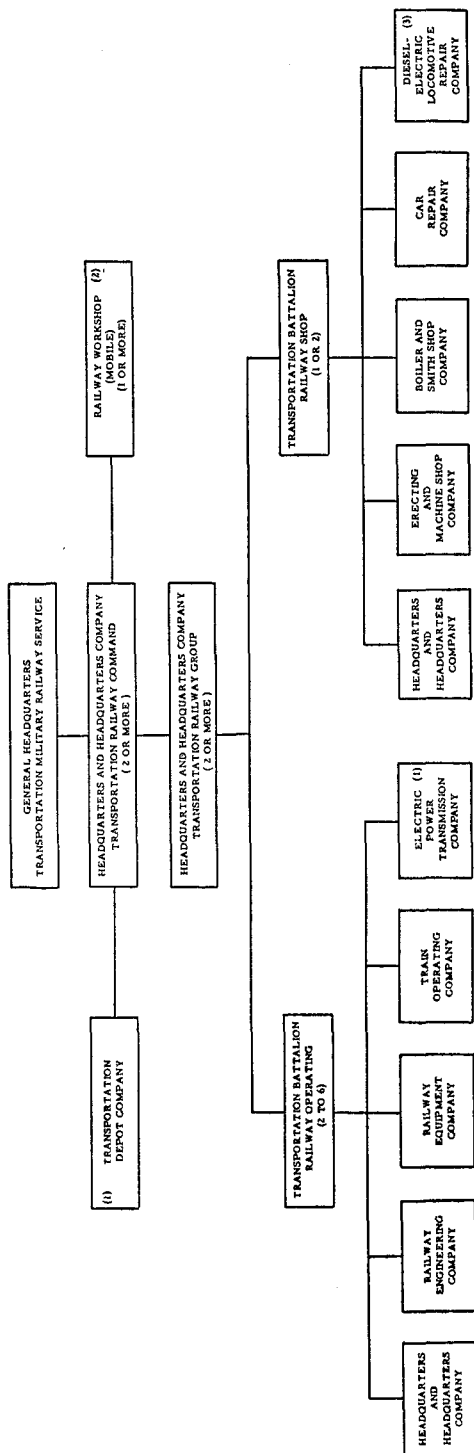
- 6th RAILWAY OPERATING BATTALION
7th RAILWAY OPERATING BATTALION
8th RAILWAY OPERATING BATTALION
9th RAILWAY OPERATING BATTALION
10th RAILWAY OPERATING BATTALION
3rd RAILWAY SHOP BATTALION
4th RAILWAY SHOP BATTALION
2nd RAILWAY WORKSHOP (MOBILE)



MILEAGE	
CHERBOURG - ST. LO	55
ST. LO - VIRE	28
VIRE - ARGENTAN	48
ARGENTAN - ALLENCON	38
ARGENTAN - LAIGLE	36
LAIGLE - DREUX	43
DREUX - PARIS	50
PARIS - SOISSONS	65
SOISSONS - LAON	70
LAON - REIMS	32
REIMS - VERDUN	71
VERDUN - VOLLIGNY	4

MILEAGE (CONT)	
POLLERY - VINZ	26
POLLONY - REINES	57
ST. MALO - REINES	35
REINES - LAVAL	56
LAVAL - LE MAUS	54
LE MAUS - ALLECON	34
LE MAUS - CHARTRES	76
CHARTRES - ETAMPES	16
ETAMPES - PARIS	38
PARIS - ESTERNAY	45
ESTERNAY - SORRESON	30
SORRESON - CORRENY	68

Figure 1. Employment of a transportation military railway service in a theater of operations.



- (1) Assigned as required. May be attached or assigned to Railway Group.
 (2) Assigned as required.
 (3) When steam locomotives only are operated, this company is not required.

Figure 2. Organization of the transportation military railway service.

States. Consequently, it provides in full for the three separate and distinct physical functions of railway operation; namely, train operation, maintenance of way, and maintenance of equipment. In addition, it provides for the functions of administration and supply.

b. To illustrate, the following is a comparison of commercial railway operating officials and commanders of transportation military railway service units.

<i>Commercial railways</i>	<i>Transportation military railway service</i>
Vice president, operations	Director general, general headquarters, transportation military railway service.
General manager	General manager, transportation railway command.
General superintendent	Group commander, transportation railway group.
Superintendent	Operations superintendent, railway operating battalion.

c. A railway operating battalion, the basic unit of the transportation military railway service, corresponds generally in personnel, duties, territory and operational jurisdiction to the organization, staff, territory, and responsibility of a division superintendent.

8. Procurement of Rail Units

a. During peacetime the only transportation military railway service units in the active military service are those required for training personnel and those required to meet oversea commitments. These are few in number. During wartime, a great number of transportation military railway service units are required. After mobilization begins there is insufficient time to organize and train these highly technical units. Consequently, the majority of transportation military railway service units utilized during wartime are reserve units called into active service.

b. Transportation military railway service reserve units are normally sponsored by United States commercial railways. The majority of the personnel in one unit will be employees of the same railway. Their TOE assignments in the units are similar to their civilian positions. Thus, these units are available for immediate call to active duty. With a minimum amount of active duty training the units are ready for employment in an active theater of operations. Since reserve units receive their technical training on the commercial railways, major items of TOE equipment are not issued to the units until they are called to active duty.

PART TWO
ORGANIZATION, FUNCTIONS, AND TRAINING
OF RAIL TRANSPORTATION UNITS

CHAPTER 3
GENERAL HEADQUARTERS, TRANSPORTATION MILITARY
RAILWAY SERVICE

9. Mission

a. The mission of the general headquarters, transportation military railway service (TOE 55-201R), is to direct the operation of military railways in a large theater of operations and to command all troops assigned to carry out the mission.

b. General headquarters, transportation military railway service, operates during periods of peace and mobilization as described in paragraph 3*b*.

10. Assignment

a. One general headquarters, transportation military railway service, is normally assigned to a theater having two or more headquarters and headquarters companies, transportation railway command (TOE 55-302R).

b. General headquarters, transportation military railway service, will be assigned to the lowest echelon of command which can direct railway operations. When the rail net is substantially within a single geographical command, general headquarters, transportation military railway service, will be assigned to that command unless there are compelling reasons to assign it to the headquarters having area jurisdiction over the whole railway system. For example, when the major portion of a rail net is in the communications zone with limited operations extending into the combat zone, general headquarters, transportation military railway service, will normally be assigned to the communications zone.

11. Capabilities

a. General headquarters, transportation military railway service, is capable of commanding two or more headquarters and headquarters companies, transportation railway commands (TOE 55-302R).

b. It is capable of overall supervision and direction of all military railways of any theater of operations.

c. Assignment or attachment of Corps of Engineers, Signal Corps, Army Medical Service, Military Police Corps, and other service type units and detachments to general headquarters, transportation military railway service, is frequently necessary. Such units and detachments must be approved by the theater of operations or communications zone commander. In addition, antiaircraft artillery and other combat troop support may be required and will be obtained in the same manner.

d. This unit is 50 percent mobile. Organic vehicles are limited to those required for unit administration, liaison, and supply. The necessary transportation must be provided to move this unit by rail or by other means.

12. Organization and Functions

General headquarters, transportation military railway service, is composed of a railway headquarters; transportation, equipment, engineering, supply, and security sections; and a headquarters company (fig. 3).

a. *Railway Headquarters.* Railway headquarters consists of the commanding officer, whose technical title is director general; the deputy director general, aides to the general officers, and the following staff officers:

- (1) *Director of personnel and administration.* The director of personnel and administration has the responsibilities and duties of a G1 to the command (FM 101-5). One of his primary responsibilities is the overall supervision of personnel classification and assignment activities and procedures within subordinate commands. He is assisted by the adjutant, who performs administrative duties to coordinate the military functions of the organization; the assistant adjutant; and three warrant officers—one for administration, one for personnel management, and one for personnel.
- (2) *Chaplain.* The chaplain is responsible for the religious activities of the organizations and matters charged to him pertaining to morale (FM 101-5).
- (3) *Fiscal officer.* The fiscal officer directs the allotment of appropriated funds according to estimated expenditures, maintains fiscal accounting records of various funds, and advises the commander and staff on fiscal matters.

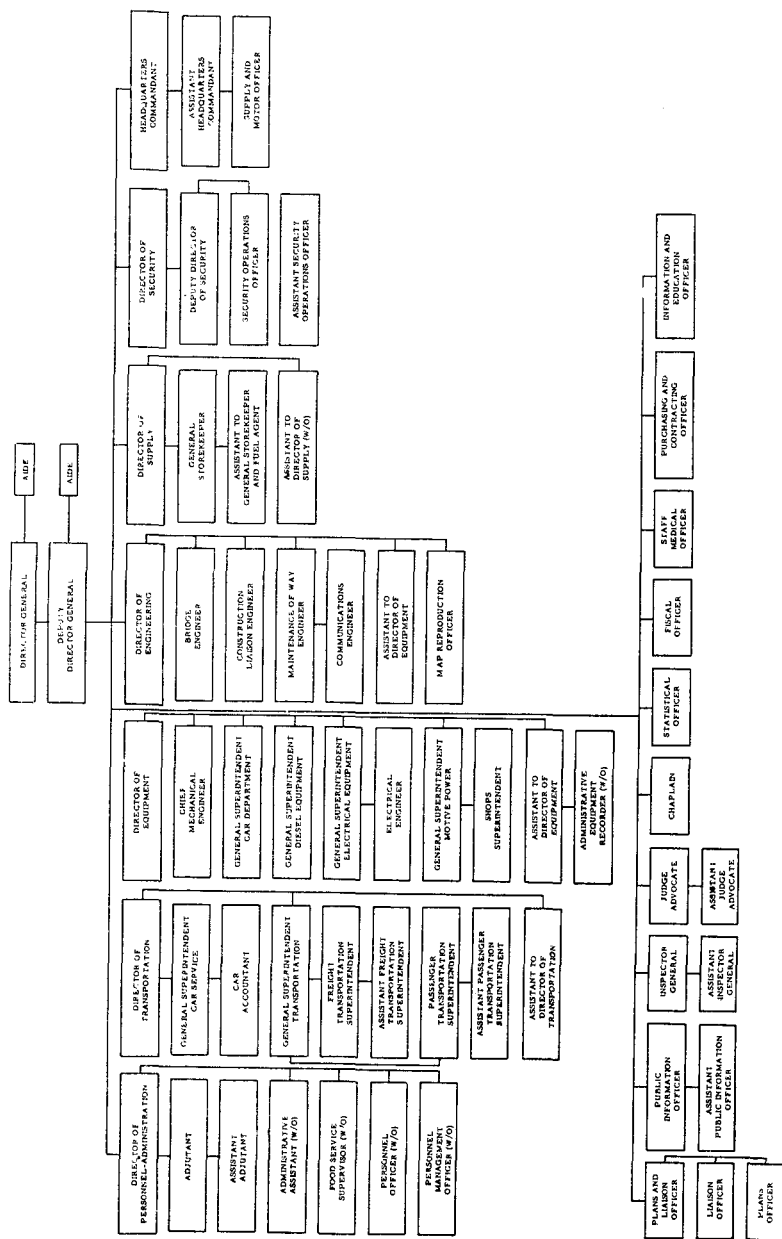


Figure 3. Functional organization of the general headquarters, transportation military railway service.

- (4) *Inspector general.* The inspector general conducts inspections and investigations as prescribed by Army Regulations and recommends remedial action to correct deficiencies and delinquencies noted (FM 101-5). He has an officer assistant.
- (5) *Judge advocate.* In addition to normal duties (FM 101-5), the judge advocate furnishes advice and assistance on legal problems concerning civilians in occupied territory during hostilities. He has an officer assistant.
- (6) *Staff medical officer.* The staff medical officer advises the commander and staff on matters pertaining to medical and veterinary services. He makes recommendations for the procurement and employment of medical detachments (FM 101-5).
- (7) *Information and education officer.* The information and education officer coordinates and supervises information and education activities in subordinate units. He advises the commander and staff on all aspects of the information and education program (FM 101-5).
- (8) *Plans and liaison officer.* The plans and liaison officer maintains liaison with other transportation corps operating agencies. He also prepares plans concerning the operation and employment of military railway service units in the theater. He is assisted by a planning officer and a liaison officer.
- (9) *Public information officer.* The public information officer supervises the preparation of news releases, special articles, posters, photographs, radio programs, and other informational matter for the command. He advises the commander and staff on all aspects of public relations (FM 101-5). He has an officer assistant.
- (10) *Purchasing and contracting officer.* The purchasing and contracting officer supervises purchasing and contracting of supplies, equipment, and services for the command.
- (11) *Statistical officer.* The statistical officer performs statistical work involving the collection, compilation, verification, analysis, and interpretation of administrative and railway data (par. 16b(3)).
- (12) *Food service supervisor.* The food supervisor exercises staff supervision over all food service activities of the command, except those delegated to the surgeon general. He interprets regulations, disseminates instructions and renders technical assistance to all food service activities of the command.

b. Transportation Section. The director of transportation, a qualified railway operations superintendent, is in charge of the transportation section. His responsibilities include coordinating train schedules, preparing train and station rules, supervising car distribution, issuing regulations for loading cars, and issuing general instructions for the makeup and movement of trains (par. 16c). The director of transportation has as assistants the following officers:

- (1) General superintendent, transportation.
- (2) General superintendent, car service.
- (3) Car accountant.
- (4) Freight transportation superintendent and assistant.
- (5) Passenger transportation superintendent and assistant.
- (6) Assistant to the director of transportation.

c. Equipment Section. The director of equipment, a qualified railway equipment superintendent, is in charge of the equipment section. His responsibilities include determining the proper type of equipment to meet operating conditions and prescribing maintenance standards for such equipment (par. 16d). The director of equipment has as assistants the following officers:

- (1) Chief mechanical engineer.
- (2) General superintendent, car department.
- (3) General superintendent, diesel equipment.
- (4) General superintendent, electrical equipment.
- (5) General superintendent, motive power.
- (6) Electrical engineer.
- (7) Shops superintendent.
- (8) Assistant to the director of equipment.
- (9) Administrative equipment recorder (warrant officer).

d. Engineering Section. The director of engineering, a qualified railway maintenance of way superintendent, is in charge of the engineering section. His responsibilities include prescribing standards of maintenance for track and structures, arranging for maintenance of way materials and supplies, and arranging for maps and work train equipment as required by subordinate units. He cooperates with the director of transportation in planning for the construction and rehabilitation of railway facilities (par. 16e). The director of engineering has as assistants the following officers:

- (1) Bridge engineer.
- (2) Construction liaison engineer.
- (3) Maintenance of way engineer.
- (4) Communications engineer.
- (5) Map reproduction officer.
- (6) Assistant to the director of engineering.

e. Supply Section. The director of supply, a qualified railway supply officer, is in charge of this section. His responsibilities are the same as any supply officer supervising the supply activities of subordinate units. In addition, he is responsible for the preparation of tables of allowances and tables of supplies required by subordinate units (par. 16f). The director of supply has as assistants the following officers:

- (1) General storekeeper.
- (2) Assistant general storekeeper and fuel agent.
- (3) Assistant to the director of supply (warrant officer).

f. Security Section. The director of security, a qualified provost marshal, is in charge of the security section. He advises and assists the director general in the supervision and operation of security measures, police matters, disciplinary regulations, and emergency plans. The director of security has as assistants the following officers who are qualified in security operations, criminal investigation, and military police work:

- (1) Deputy director of security.
- (2) Security operations officer and assistant.

g. Headquarters Company. The headquarters company commander is the headquarters commandant. His responsibilities include the normal administrative activities for the enlisted personnel of the general headquarters. He is also responsible for billeting, supply and messing of the personnel and for the operation and maintenance of motor vehicles for the general headquarters. He has as assistants the following officers:

- (1) Assistant headquarters commandant.
- (2) Supply and motor officer.

CHAPTER 4

HEADQUARTERS AND HEADQUARTERS COMPANY, TRANSPORTATION RAILWAY COMMAND

13. Mission

The mission of the headquarters and headquarters company, transportation railway command (TOE 55-302R), is to exercise command and supervision over two or more transportation railway groups (TOE 55-202R).

14. Assignment

a. When a headquarters and headquarters company, transportation railway command, is the senior railway headquarters in a theater, it will be assigned in the same manner as prescribed for a general headquarters, transportation military railway service in paragraph 10*b*.

b. When two or more headquarters and headquarters companies, transportation railway command, are required in the same theater due to the size or complexity of railway operations, they are assigned to general headquarters, transportation military railway service (TOE 55-201R) (ch. 3).

15. Capabilities

a. The headquarters and headquarters company, transportation railway command, is capable of commanding two or more transportation railway groups (TOE 55-202R).

b. It is capable of overall supervision and direction of a large railway system.

c. The Corps of Engineers, Signal Corps, Army Medical Service, Military Police Corps, and other service-type units and detachments may be operationally necessary. Units of other services are usually attached to the command or to the group, whichever is the highest echelon, when approved by the theater of operations or communications zone commander. In addition, antiaircraft artillery and other combat troop support may be required and will be obtained in the same manner.

d. Organic motor vehicles are limited to those required for unit administration, liaison, and supply. To move this unit by rail or by any other means, the necessary transportation must be provided.

16. Organization and Functions

Headquarters and headquarters company, transportation railway command, is divided into a command headquarters and a headquarters company. Command headquarters is composed of the following sections: command, administrative, operations, equipment, engineering, and supply (fig. 4).

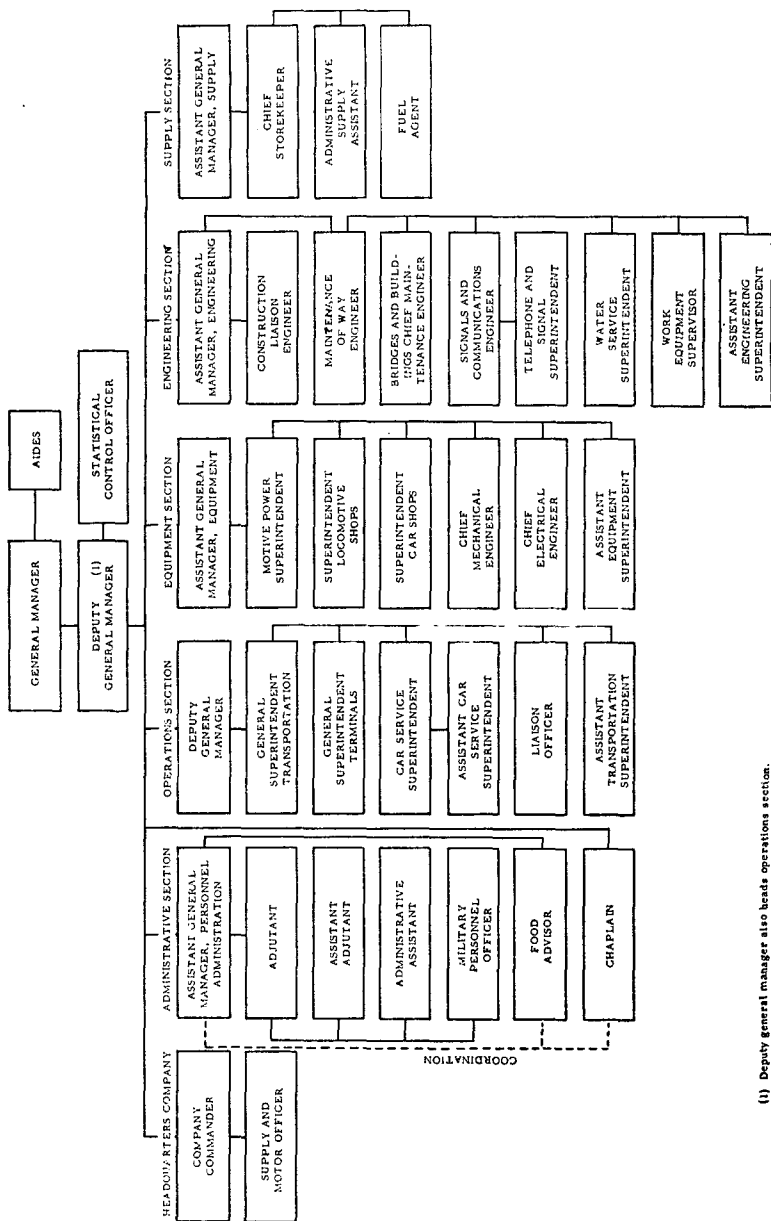
a. Command Section. The command section consists of the commanding officer, whose technical title is general manager; the deputy general manager; and aides to the general officer.

b. Administrative Section. The assistant general manager, personnel-administration, is in charge of the administrative section. This officer has the responsibilities and duties of a G1 to the command (FM 101-5). One of his primary responsibilities is efficient and accurate classification and assignment of personnel with the technical skills found in transportation military railway service organizations. He is assisted by the following:

- (1) *Adjutant.* The adjutant performs personnel and administrative duties to coordinate the military functions of the organization. He is assisted by an assistant adjutant and two warrant officers (one an administrative assistant and the other for military personnel work).
- (2) *Chaplain.* See paragraph 12a(2) and FM 101-5.
- (3) *Food adviser.* See paragraph 12a(12).

c. Operations Section. The deputy general manager is a qualified railway operations superintendent. Although not assigned to the operations section, he supervises and coordinates the work. The responsibilities of this section include the designation of the geographical limits to be operated by the railway group and operating battalions, the supervision and coordination of all train service of subordinate units, the submission of recommendations for construction and reconstruction of railway facilities necessary for adequate railway service, and the coordination of all railway planning activities. Officers assigned to this section include the following:

- (1) *General superintendent, transportation.* The general superintendent, transportation, is responsible for the coordination of schedules between railway groups and the assignment of motive power to groups. He recommends improvements to existing facilities and issues transportation rules and instructions necessary to insure uniform practices and methods. He is assisted by the assistant transportation superintendent.



(1) Deputy general manager also heads operations section.

Figure 4. Functional organization of headquarters and headquarters company, transportation railway command.

- (2) *General superintendent, terminals.* The general superintendent, terminals, is charged with technical supervision over military railway operations within depots, ports, and other large terminals. He is charged with the prompt receipt, classification, and dispatch of trains and the prompt handling and forwarding of cars. Other responsibilities include recommendations for construction and reconstruction of loading and unloading facilities necessary for adequate railway service in terminals.
- (3) *Car service superintendent.* The car service superintendent is responsible for technical supervision over car distribution. He issues general instructions as to load limits and clearances. When necessary, he traces lost cars and expedites and coordinates important shipments.
- (4) *Liaison officer.* The liaison officer is qualified as a railway operations superintendent. He maintains liaison with such agencies as directed.

d. Equipment Section. The assistant general manager, equipment, a qualified railway equipment superintendent, is in charge of the equipment section. His responsibilities include determining the proper type of equipment to meet operating conditions and prescribing policies for maintenance of equipment. He will assist the assistant general manager, supply, in preparing long range supply estimates. His assistants include the assistant equipment superintendent and the following officers:

- (1) *Motive power superintendent.* The motive power superintendent recommends assignment of motive power to meet requirements of the railway groups and operating battalions. He formulates rules for the operation and maintenance of locomotives and locomotive cranes. He provides adequate inspection service and exercises technical supervision over repair and maintenance of locomotives and locomotive cranes.
- (2) *Superintendent of locomotive shops.* The superintendent of locomotive shops exercises technical supervision over locomotive shop operation. He prescribes rules governing methods of repair and shop practices and supervises procurement of locomotive shop equipment.
- (3) *Superintendent of carshops.* The superintendent of carshops exercises technical supervision over carshop operation. He prescribes rules governing methods of repair and shop practices and supervises procurement of carshop equipment.

- (4) *Chief mechanical engineer.* The chief mechanical engineer is charged with technical supervision over arrangement, operation, and maintenance of shop machinery and mechanical equipment of buildings. He formulates designs for locomotives and railway cars and determines changes, alterations, or improvements to equipment and shop practices. He assists the superintendents of motive power and shops.
- (5) *Chief electrical engineer.* The chief electrical engineer has direct supervision over all electrical equipment used by subordinate units. This electrical equipment includes stationary power units assigned to the transportation military railway service. He assists the motive power superintendent, the shop superintendents, and the chief mechanical engineer in technical matters pertaining to electrical equipment.

e. Engineering Section. The assistant general manager, engineering, a qualified railway maintenance of way superintendent, is in charge of the engineering section. He prescribes standards for construction, rehabilitation, and maintenance of track and structures. He allocates materials, supplies, and work train equipment as required. In cooperation with the assistant general manager, transportation, he prepares detailed plans for construction and rehabilitation of railway facilities to accomplish the rail transportation mission. He will assist the assistant general manager, supply, in preparing long range supply estimates. His assistants include the assistant engineering superintendent and the following officers:

- (1) *Construction liaison engineer.* The construction liaison engineer acts as technical adviser to the commanders of engineer troops engaged in railway construction and rehabilitation. He assures that such work meets transportation military railway service standards. He may be assigned other engineering duties.
- (2) *Maintenance of way engineer.* The maintenance of way engineer exercises technical supervision over maintenance of track and structures performed by subordinate railway units.
- (3) *Bridges and buildings chief maintenance engineer.* The bridges and buildings chief maintenance engineer, under the control of the maintenance of way engineer, exercises technical supervision over maintenance of bridges, tunnels, buildings, and all other railway structures on the rail lines of subordinate units.

- (4) *Signals and communications engineer.* The signals and communications engineer exercises technical supervision over the installation and maintenance of signals, control tower apparatus, interlocking plants, and track circuits on the rail lines of subordinate units. He also exercises technical supervision over the maintenance of communications circuits that have been turned over to the transportation military railway service. He is assisted by a telephone and signal superintendent.
- (5) *Water service superintendent.* The water service superintendent exercises technical supervision over the location and operation of all railway locomotive water stations in subordinate units. He also exercises technical supervision over water treatment and the maintenance of piping and mechanical appliances connected with these water stations. He coordinates all railway requirements for water and arranges with the engineer service for adequate supply.
- (6) *Work equipment supervisor.* The work equipment supervisor exercises technical supervision over the acquisition, movement, assignment, maintenance, and operation of all engineering department work equipment assigned to, or being used by, subordinate units.

f. Supply Section. The assistant general manager, supply, a qualified railway storekeeper, is in charge of the supply section. He coordinates with other sections in preparing long range supply estimates. His responsibilities include supervision and coordination of the supply activities of subordinate units. When a transportation depot company is attached or assigned to the transportation military railway service, the assistant general manager, supply, exercises full control over the stores and supplies in the depot. He will be responsible for the maintenance of supply levels by the depot company. His assistants include the following officers:

- (1) *Chief storekeeper.* The chief storekeeper is general assistant in all functions to the assistant general manager, supply. He is assisted by an administrative supply assistant (warrant officer).
- (2) *Fuel agent.* The fuel agent exploits sources of fuel supply. He assures the maintenance of adequate fuel reserves on the rail lines of subordinate units.

g. Headquarters Company. The headquarters company commander is responsible for normal administrative activities for the enlisted personnel of headquarters and headquarters company. He

is also responsible for the billeting, supply and messing of personnel, and the maintenance of motor vehicles for the headquarters and headquarters company. He is assisted by a supply and motor officer.

h. Statistical Control Officer. The statistical control officer supervises the preparation, consolidation, and submission of regular and special statistical reports. Such reports concern personnel, training, supply, housing, equipment, and facilities. Included in facilities are track, structures, stations, signals, communications, watering and fueling points, yards and shops, and electrification. Such reports also concern load limits, clearances, construction, maintenance, operations, guerilla activity. He correlates, prepares and maintains cost record data.

CHAPTER 5

HEADQUARTERS AND HEADQUARTERS COMPANY, TRANSPORTATION RAILWAY GROUP

17. Mission

The mission of the headquarters and headquarters company, transportation railway group (TOE 55-202R), is to command, administer, and supervise assigned railway operating battalions, railway shop battalions, and attached units.

18. Assignment

a. This unit is normally assigned to headquarters and headquarters company, transportation railway command (TOE 55-302R).

b. It may operate separately under the operational control of the appropriate staff transportation officer.

c. When the transportation railway group is the highest echelon of the transportation military railway service in the theater, it will be assigned in accordance with paragraph 10*b*.

19. Capabilities

a. The railway group is capable of supervising and administering two to six railway operating battalions, one or two railway shop battalions, and attached teams from Transportation Corps service organizations (TOE 55-500R).

b. The railway group is also capable of supervising and administering units assigned or attached from the Military Police Corps, Signal Corps, and other services.

c. Organic motor vehicles are limited to those required for unit administration, liaison, and supply. The group normally moves by rail; however, to move this unit by rail or any other means, the necessary transportation must be provided.

20. Organization and Functions

The headquarters and headquarters company, transportation railway group, consists of group headquarters and headquarters company. Headquarters company is composed of company headquarters and the following sections: administrative, security, operations, engineering, equipment, and supply. All officers except the company commander are assigned to group headquarters. En-

listed personnel are assigned to company headquarters and the various sections. The duties and responsibilities of the officers will be discussed under the sections in which they function (fig. 5).

a. Group Headquarters. Group headquarters consists of the group commander, whose technical title is general superintendent, and the executive officer, whose technical title is assistant general superintendent. Both are qualified railway operations superintendents. The military duties of the group commander are the same as all commanding officers; his technical responsibilities encompass the efficient operation of his unit and all assigned and attached subordinate units.

b. Company Headquarters. The headquarters company commander is responsible for normal administrative activities for the enlisted personnel of headquarters company. He is also responsible for the billeting, supply, and messing of personnel and for the maintenance of motor vehicles for headquarters and headquarters company. Teletypewriter and switchboard operators are furnished by company headquarters.

c. Administrative Section. The adjutant-S1 is in charge of the administrative section. He performs administrative and personnel duties to coordinate the military functions of the organization. He is assisted by two warrant officers—one for personnel and the other a food adviser.

d. Security Section. The security operations officer is in charge of the security section. He plans for and assures the proper security of all buildings, structures, and equipment of the organization and of all supplies in transit by rail. He coordinates active and passive defense measures for the railway group and subordinate units.

e. Operations Section. The operations (S3) officer, a qualified railway operations superintendent, is in charge of the operations section. He is responsible for the coordination of timetables between operating battalions and exercises technical supervision over train movements and the operation of terminals. Other responsibilities are coordinating operational planning activities of the railway group and prescribing the required train operational reports. He is assisted by an assistant transportation superintendent and the following officers:

- (1) *Car service superintendent.* The car service superintendent is responsible for technical supervision over car distribution and car records. He compiles and distributes information concerning load limits and clearances. When necessary, he traces lost cars and expedites and coordinates important shipments.

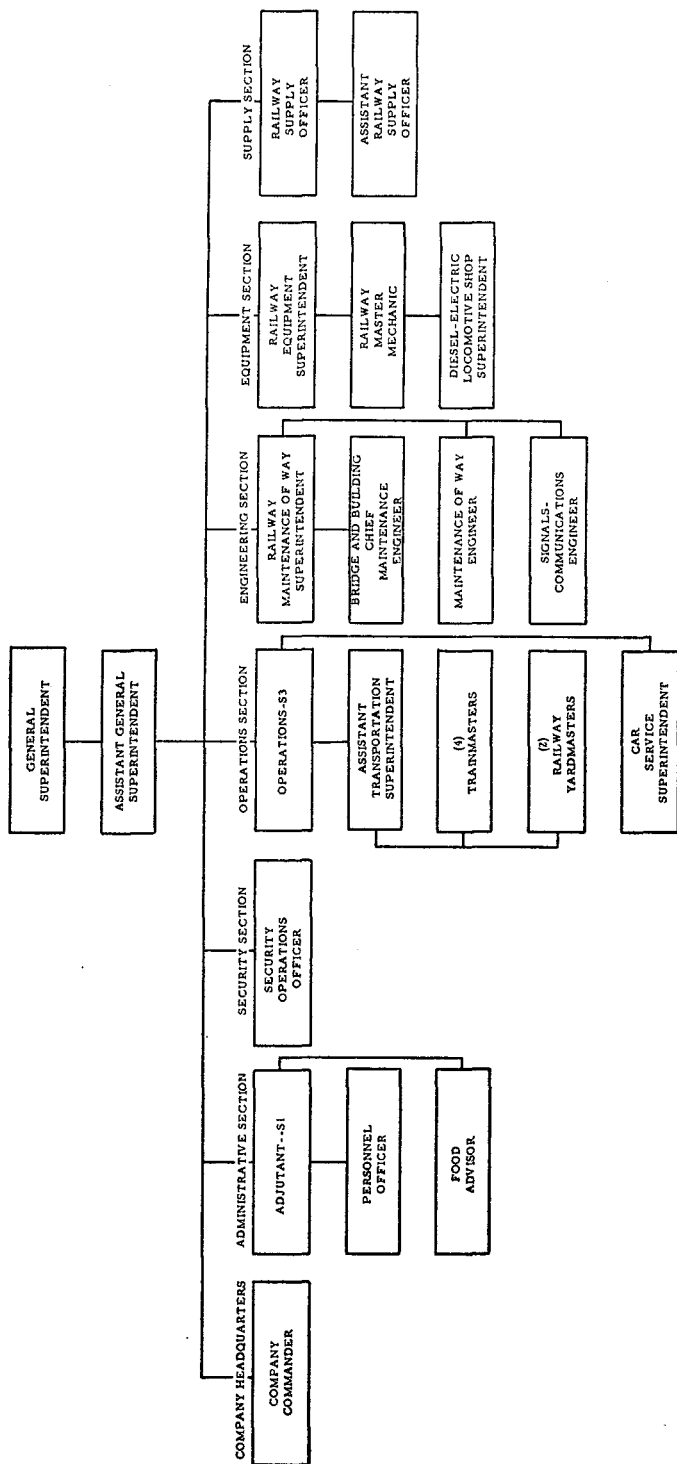


Figure 5. Functional organization of the transportation railway group.

- (2) *Railway yardmasters.* The railway yardmasters are usually stationed at large terminals where bottlenecks occur or are likely to occur. They observe the terminal railway operations and recommend improvements where necessary.
- (3) *Trainmasters.* The trainmasters ride trains throughout the territory of the railway group. They recommend improvements in train handling, operating procedures, and personnel utilization.

f. Engineering Section. The railway maintenance of way superintendent is in charge of the engineering section. He exercises technical supervision over the maintenance of track, structures, and track equipment. Other responsibilities are coordinating all maintenance of way activities for the railway group and allocating maintenance of way supplies and equipment to railway operating battalions as required. His section performs railway engineering drafting work for the entire railway group as required. He is assisted by the following officers:

- (1) *Bridge-building chief maintenance engineer.* The bridge-building chief maintenance engineer exercises technical supervision over maintenance of bridges, tunnels, buildings, and other structures.
- (2) *Maintenance of way engineer.* The maintenance of way engineer exercises technical supervision over all track and roadbed maintenance.
- (3) *Signal-communication engineer.* The signal-communication engineer is in charge of the communication section. He exercises technical supervision over the installation and maintenance of signals, control tower apparatus, interlocking plants, track circuits, and telephone lines.

g. Equipment Section. The railway equipment superintendent is in charge of the equipment section. He exercises technical supervision over the assignment, maintenance, and operation of motive power, the maintenance of cars and work train equipment; and the operation of railway shops and enginehouses. His section performs mechanical drafting work for the entire group as required. He is assisted by a railway master mechanic and diesel locomotive shop superintendent.

h. Supply Section. The railway supply officer is in charge of the supply section. He coordinates supply requirements of the railway battalions and exercises technical supervision over the activities of battalion storekeepers. When established, he supervises the operation of railway stores depots. He is assisted by an assistant railway supply officer.

CHAPTER 6

TRANSPORTATION RAILWAY OPERATING BATTALION

21. General

The transportation railway operating battalion is the basic unit of the transportation military railway service. It is the operating unit for the smallest self-contained railway zone, called a railway division, which corresponds to an operating division on a United States commercial railway. Limits of the division are determined by the length of the main line, the number and location of branch lines, the density of traffic, and the terminal facilities. The length of a railway division will vary from 90 to 150 miles, but it will average approximately 100 miles (fig. 6). The battalion is not equipped for railway construction and major rehabilitation, or for heavy repairs to railway motive power and rolling stock (FM 55-122).

22. Mission

The mission of the transportation railway operating battalion (TOE 55-225R) is to operate and maintain a military railway division in a theater of operations.

23. Assignment

- a. The transportation railway operating battalion is normally assigned to a transportation railway group (TOE 55-202R).
- b. The transportation railway operating battalion may be assigned to a transportation railway command (TOE 55-302R).
- c. A railway operating battalion may operate alone at an isolated location. In this case it will be attached to the military command which it is supporting, but it will remain assigned to the transportation military railway service. The supported command will furnish logistical support to the battalion.

24. Capabilities

- a. The transportation railway operating battalion is capable of operating and maintaining a railway division, including the main line, yards, sidings, terminals, enginehouses, and structures required for coordinated action.
- b. The full capabilities of the battalion may be utilized in the operation and maintenance of a large railway terminal.

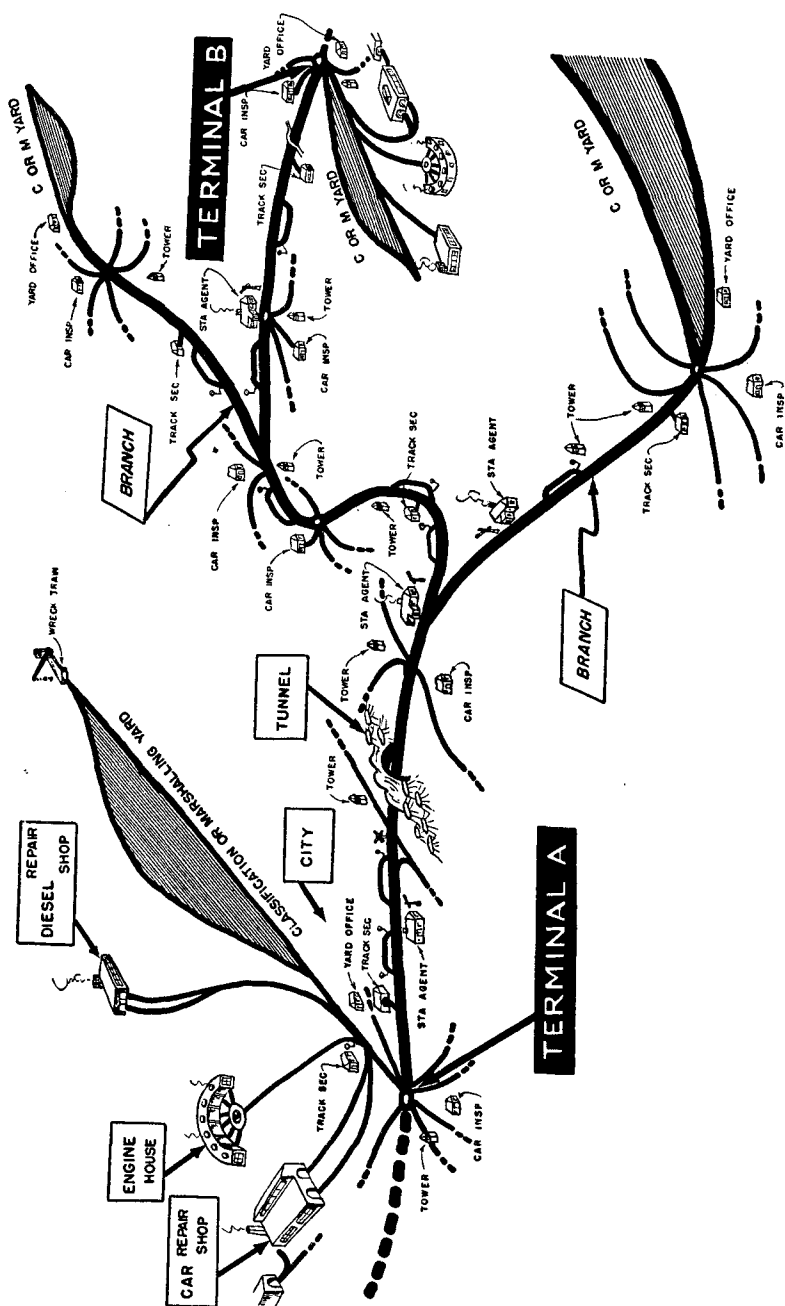


Figure 6. Employment of a railway operating battalion in a theater of operations.

c. The battalion organically provides 50 train and engine crews of which 40 may be available on an engine-day basis.

d. The battalion can perform organizational and field maintenance on approximately 40 locomotives and 800 railway cars. It can also perform running inspection to approximately 2,000 railway cars monthly.

e. The battalion can inspect and maintain approximately 90 to 150 miles of railway right-of-way, including track, bridges, tunnels, structures, buildings, railway signals, and electrical communications.

25. Organization and Functions

a. General.

(1) A railway operating battalion consists of four organic companies as follows:

(a) Headquarters and headquarters company (TOE 55-226).

(b) Railway engineering company (TOE 55-227R).

(c) Railway equipment company (TOE 55-228R).

(d) Train operating company (TOE 55-229).

(2) When operating an electrified railway, an electric power transmission company (TOE 55-217R) may be assigned to the battalion.

(3) The locomotive repair platoon of the railway equipment company may be organized to maintain steam, diesel-electric, or steam and diesel-electric motive power.

b. Headquarters and Headquarters Company. The battalion commander has the technical title of railway operations superintendent. Included in headquarters and headquarters company are the assistant superintendent, chief dispatcher, supply officer, and road foreman of engines. The technical functions of headquarters and headquarters company are to plan, supervise, and coordinate operations of the units of the battalion; dispatch all trains operated by the battalion; operate the railway stations and towers of the division; and assign motive power which comes under the jurisdiction of the battalion.

c. Railway Engineering Company. The railway engineering company commander has the technical title of maintenance of way superintendent. The company consists of four platoons, as follows:

(1) *Two track maintenance platoons.* The track maintenance platoons are responsible for the inspection and maintenance of roadbed, track, right-of-way, station grounds, driveways, crossings, and fences.

- (2) *Bridge and building maintenance platoon.* The bridge and building maintenance platoon is responsible for inspection and maintenance of bridges, culverts, tunnels, cattle guards, track signs, fueling and watering facilities, buildings, and other structures.
- (3) *Communications and railway signal maintenance platoon.* The communications and railway signal maintenance platoon is responsible for the inspection and maintenance of land line communications used solely by the railway division, and the installation, inspection, and maintenance of railway signaling equipment.

d. Railway Equipment Company. The railway equipment company commander has the technical title of railway master mechanic. The company consists of two platoons, as follows:

- (1) *Car repair platoon.* The car repair platoon is responsible for the inspection and maintenance (organizational and field) of railway cars; the operation of wreck trains; and the execution of all sign painting.
- (2) *Locomotive repair platoon.* The locomotive repair platoon may be organized as a steam, diesel-electric, or steam and diesel-electric locomotive repair platoon, depending on the type of motive power assigned to the division. It is responsible for the inspection and maintenance (organizational and field) of locomotives and locomotive cranes, the repair of tools and mechanical equipment for all companies of the battalion, and the operation and maintenance of fuel and lubrication facilities.

e. Train Operating Company. The train operating company commander has the technical title of railway trainmaster. The company consists of two train operating platoons, each containing 25 train and engine crews. These platoons operate the trains between terminals and are responsible for performing switching work in the yards and terminals.

f. Electric Power Transmission Company. The electric power transmission company commander has the technical title of electric power transmission superintendent. The company consists of two electric power platoons. It is responsible for the maintenance of the electric power supply facilities (catenary or third rail) on an electrified division, the supervision of the load and distribution of electric current, and the operation of substations. It is not responsible for the actual generation of electric power, whether thermal or hydroelectric. This is a responsibility of the Corps of Engineers.

CHAPTER 7

TRANSPORTATION RAILWAY SHOP BATTALION

26. Mission

The mission of the transportation railway shop battalion (TOE 55-235R) is to perform depot maintenance on the steam and/or diesel-electric locomotives and rolling stock of a military railway (fig. 7).

27. Assignment

a. The transportation railway shop battalion is normally assigned to a transportation railway group (TOE 55-202R).

b. The transportation railway shop battalion may be assigned to a transportation railway command (TOE 55-302R).

28. Capabilities

a. The transportation railway shop battalion is capable of performing depot maintenance support to motive power and rolling stock for two to four railway operating battalions.

b. It can perform depot maintenance support for 100 steam locomotives, 200 diesel-electric locomotives (units), and 2,500 railway cars.

c. It can perform depot maintenance on 10 steam locomotives, 25 diesel-electric locomotives (units), and 600 railway cars per month.

d. For operations in which only steam power is utilized, this battalion may be activated without the transportation diesel-electric locomotive repair company (TOE 55-247R). When so activated, the battalion is capable of performing depot maintenance on 12 steam locomotives and 600 railway cars per month.

e. The battalion is also capable of making repairs to subassemblies and manufacturing parts for railway operating battalions.

29. Organization and Functions

A railway shop battalion consists of five organic companies: headquarters and headquarters company (TOE 55-236R), transportation erecting and machine shop company (TOE 55-237R), transportation boiler and smith shop company (TOE 55-238R), transportation car repair company (TOE 55-239R), and transportation diesel-electric locomotive repair company (TOE 55-247R).

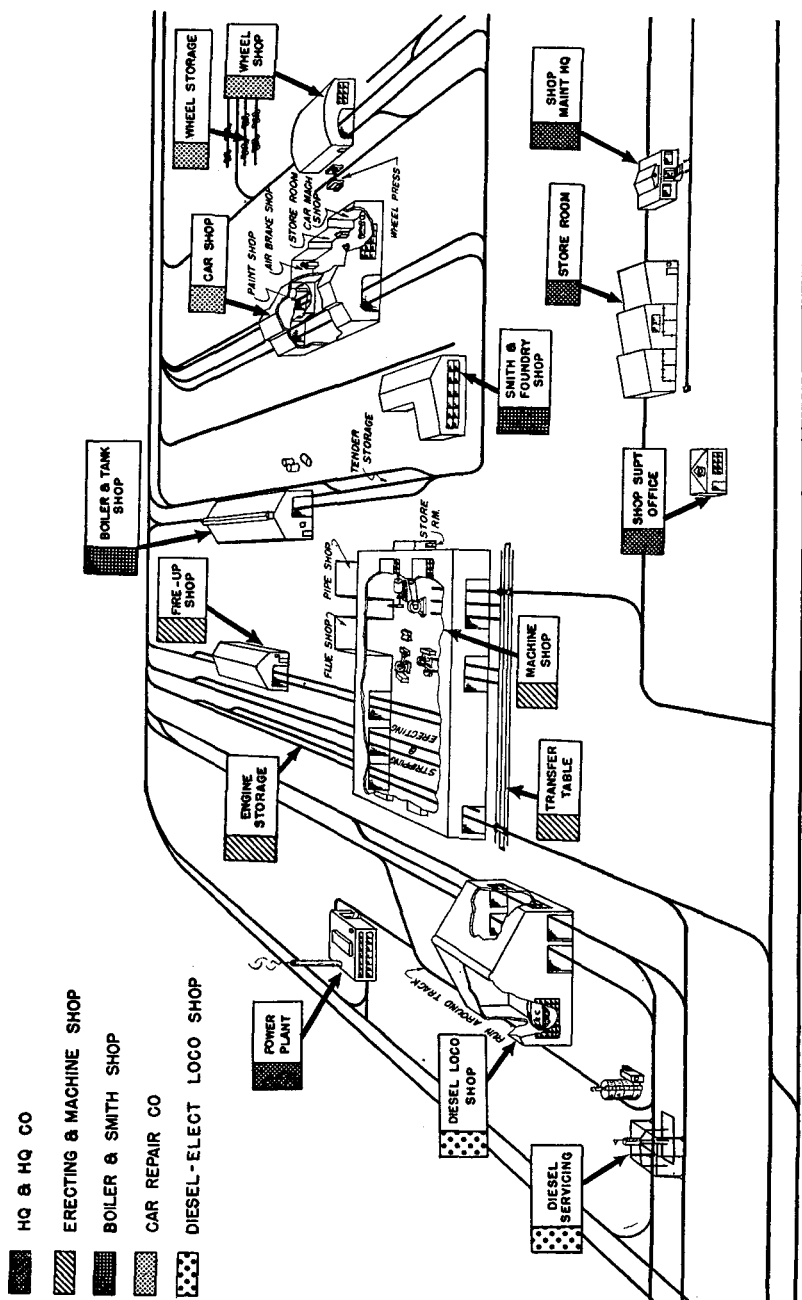


Figure 7. Employment of a railway shop battalion in a theater of operations.

a. *Headquarters and Headquarters Company.* The battalion commander has the technical MOS title of railway shop superintendent. Included in headquarters and headquarters company are the assistant shop superintendent, railway supply officer, and railway shop maintenance engineer. The technical functions of headquarters and headquarters company are to plan, coordinate, and supervise the operations of the units of the battalion; inspect and schedule equipment received for repairs; maintain shop buildings and machinery; and perform mechanical drafting work.

b. *Transportation Erecting and Machine Shop Company.* The transportation erecting and machine shop company commander has the technical title of transportation erecting and machine shop superintendent. The company consists of two platoons, as follows:

- (1) *Transportation erecting shop platoon.* The transportation erecting shop platoon is responsible for the stripping and assembly of steam locomotives received for repairs. This platoon also inspects and tests repaired locomotives.
- (2) *Machine shop platoon.* The machine shop platoon is responsible for machining manufactured parts; dismantling, repairing, and assembling steam locomotive subassemblies; maintaining and repairing air brake equipment; and designing or fabricating tools and dies for all units assigned to the railway group.

c. *Transportation Boiler and Smith Shop Company.* The transportation boiler and smith shop company commander has the technical title of transportation boiler and smith shop superintendent. The company consists of three platoons, as follows:

- (1) *Boilershop platoon.* The boilershop platoon is responsible for repair and manufacturing operations on boilers, tanks, and steel structural work.
- (2) *Smith shop platoon.* The smith shop platoon is responsible for forging, including tool forging and dressing, heat treating, and springmaking.
- (3) *Pipe and tinshop platoon.* The pipe and tinshop platoon is responsible for pipefitting, sheet metal work, copper-smithing, brazing, babbitting, and brass molding.

d. *Transportation Car Repair Company.* The transportation car repair company commander has the technical title of carshop superintendent. The company consists of three platoons, as follows:

- (1) *Stripping and erecting platoon.* The stripping and erecting platoon is responsible for dismantling or stripping freight cars received for repairs; distributing bad order components to repair sections; performing minor repairs

such as repairing frames, applying steel framing, bolting, reaming, and riveting; assembling cars using parts or subassemblies from stock or repair sections; and delivering assembled cars to the finishing platoon.

- (2) *Fabricating and woodworking platoon.* The fabricating and woodworking platoon is responsible for repair of car subassemblies and for fabricating and applying wood floors, sidings, ends, roofs, running boards, and doors. This platoon also operates the wheel and axle shop.
- (3) *Finishing platoon.* The passenger car section of the finishing platoon is responsible for dismantling, making minor mechanical repairs to, and assembling passenger cars; reupholstering seats; making or repairing cabinets; and performing canvas work. This section also performs all painting of locomotives, freight cars, and passenger cars. The freight car section of this platoon is responsible for completing the assembly of freight cars; repairing air brakes on both passenger and freight cars; repairing passenger car windows; and performing electrical work on passenger cars.

e. Transportation Diesel-Electric Locomotive Repair Company. The company commander has the technical title of transportation diesel-electric locomotive shop superintendent. Company headquarters personnel inspect the diesel-electric locomotives received for repair, operate and maintain cranes, and perform hostler service. The company consists of two platoons, as follows:

- (1) *Diesel engine platoon.* The diesel engine platoon is responsible for dismantling and assembling diesel-electric locomotives received for repair. In conjunction with the diesel-electrical platoon, it assembles and tests new diesel-electric locomotives. This platoon repairs diesel engines and inspects and makes minor repairs to air brake systems. Major repairs to air brake systems are performed by the car repair company. The diesel engine platoon also repairs diesel-electric locomotive wheels, bearings, draft gear, and safety appliances.
- (2) *Diesel-electrical platoon.* The diesel-electrical platoon is responsible for dismantling, repairing, and assembling diesel-electric locomotive traction and generator motors. It repairs, bakes, and tests armatures. It also repairs electrical control equipment, panelboards, electric switches, and headlight equipment on diesel-electric locomotives. In conjunction with the diesel engine platoon, it assembles and tests new diesel-electric locomotives.

CHAPTER 8

MILITARY RAILWAY SERVICE

30. General

The units of the transportation military railway service presented in previous chapters are standard organizations designed to meet average requirements under general operating conditions in a theater of operations. However, conditions vary considerably between theaters or within one theater at different times. To deal effectively with these varying requirements, the transportation depot company (TOE 55-260R) and cellular units from (TOE 55-500R) are available to support and supplement the transportation military railway service.

31. Transportation Depot Company

a. The mission of the transportation depot company (TOE 55-260R) is to provide for the receipt, storage, and issue of all Transportation Corps items of supply and equipment. This unit is capable of receiving and issuing approximately 7,000 tons per month. Depot companies may be attached or assigned to the transportation military railway service.

b. Large railway stores subdepots (par. 106) should be located at points where they can support the routine requirements for operating and maintenance supplies of two to six railway divisions. Since sufficient personnel are not provided in the tables of organization of railway supervisory units, depot companies are utilized to receive, store, and issue supplies.

c. When Transportation Corps depot companies are attached or assigned to the transportation military railway service, such attachment or assignment is on the basis of one or more per railway command. Normally one depot company can support two railway groups. When supporting two railway groups, the depot headquarters is located near the railway command headquarters and one depot platoon is located in the territory of each railway group.

d. When a Transportation Corps depot company is attached or assigned to the transportation military railway service, the assistant general manager, supply, of the railway command will exercise full control over the supplies and equipment in the depot. He will process and approve requisitions and will also be responsible for the maintenance of supply levels by the depot company. He may

delegate these functions to railway group supply officers insofar as they apply to the stores depot located in the territory of each railway group.

32. Railway Workshop (Mobile)

a. General. The railway workshop (mobile) (TOE 55-500R) is the largest of the transportation military railway service supplementary units. Although the mobile workshop does not possess the variety of personnel and equipment found in the railway shop battalion, its capabilities, with the possible exception of general over-haul work, closely parallel those of the shop battalion.

b. Mission. The mission of the railway workshop (mobile) is to perform forward area third echelon repairs on steam and diesel-electric locomotives and railway cars when stationary facilities are inadequate.

c. Assignment. The railway workshop (mobile) is assigned to the railway command. In actual use, however, mobile workshops will be attached for operation to the various railway groups. There should be at least one mobile workshop with each railway group in the theater of operations.

d. Equipment. This unit is equipped with some backshop repair and erecting machinery which is installed in railway cars. Normally the equipment is mounted in a train of boxcars consisting of five 40-ton cars or six 30-ton cars. When 40-ton cars are used, only one car will be required for machinshop service; if 30-ton cars are used, two connected cars will be required. Additional cars for mess and quarters may be added if required. The equipment cars consist of the following units:

- (1) Machinshop car(s).
- (2) Diesel-airbrake-electric car.
- (3) Pipeshop-forge-welding car.
- (4) Powerplant car.
- (5) Shop stores car.

e. Functions. The functions of the mobile workshop include the following:

- (1) Provide backshop support to enable early beginning of rail operations during the initial phase of a military operation before the arrival of a railway shop battalion.
- (2) Facilitate rapid expansion of military railway service by affording mobile shop facilities in advance of the railway shop battalions.
- (3) Perform sufficient repairs in forward areas to restore war-damaged equipment to service or permit its removal to a railway backshop.

- (4) Perform repairs in forward areas in order to maintain equipment in an operable condition and avoid the return of such equipment long distances to a railway backshop.
- (5) Augment a railway shop battalion in lieu of an additional shop battalion.
- (6) Provide the power and machine tools necessary to operate a railway shop in a devastated area.

33. Ambulance Train Maintenance Units

a. General. Although ambulance trains are under the operational control of the theater surgeon, the trains are maintained and moved over the railway line by the transportation military railway service. Ambulance train maintenance units are provided to afford ambulance trains the priority and specialized service which they require. Since ambulance trains may be expected to operate over all military railways in the theater, it is logical that the ambulance train maintenance units be assigned to the railway command. These units are normally located at ambulance train stabling points.

b. Ambulance Train Maintenance Section (TOE 55-500R). The ambulance train maintenance section, consisting of 1 officer and 18 enlisted men, is capable of performing field maintenance on 4 ambulance trains.

c. Ambulance Train Maintenance Crew (TOE 55-500R). The ambulance train maintenance crew, consisting of three enlisted men, travels with each ambulance train. It performs minor maintenance and running repairs required while the train is en route. When the ambulance train is not being operated, this crew assists the ambulance train maintenance section.

34. Additional Maintenance of Equipment Units

In addition to ambulance train maintenance units, TOE 55-500R contains the following maintenance of equipment cellular units available primarily for augmenting the capabilities of the railway equipment company of the railway operating battalion.

a. Steam Locomotive Maintenance Crew (Team EF). Team EF can perform field maintenance on seven steam locomotives at an outlying location.

b. Steam Locomotive Maintenance Crew (Team EM). Team EM can perform field maintenance on 15 steam locomotives at an outlying location.

c. Diesel-Electric Locomotive Maintenance Crew (Team ED). Team ED can perform field maintenance on seven diesel-electric locomotives and 25 railway cars at an outlying location.

d. *Diesel-Electric Locomotive Maintenance Crew (Team EJ)*. Team EJ can perform field maintenance on 15 diesel-electric locomotives and 50 railway cars at an outlying location.

e. *Railway Car Repair Crew (Team EG)*. Team EG can inspect and perform field maintenance on 300 to 350 railway cars at outlying locations.

f. *Railway Car Repair Crew (Team EN)*. Team EN can inspect and perform field maintenance on 500 to 650 railway cars at outlying locations.

35. Maintenance of Way Units

The following maintenance of way cellular units (TOE 55-500R) are available for augmenting the capabilities of the railway engineering company of the railway operating battalion:

a. *Railway Section Crew (Team EE)*. Team EE can maintain approximately 15 miles of track.

b. *Bridge and Building Maintenance Crew (Team EL)*. Team EL can maintain the bridges and buildings along approximately 45 to 75 miles of track.

c. *Railway Maintenance of Way Crew (Team EQ)*. Team EQ can maintain approximately 40 miles of track (including structures, communications, and signals) within a large terminal area.

d. *Signal and Communication Maintenance Crew (Team EI)*. Team EI can maintain railway signal and communication equipment along approximately 90 to 150 miles of track. It may be used in a large terminal area containing an equivalent track mileage.

36. Operating Units

The following cellular units (TOE 55-500R) are available for augmenting the capabilities of the train operating company and the train movement section of headquarters company of the railway operating battalion:

a. *Railway Station Detachment (Team EB)*. Team EB can operate a small or medium-size on-line railway station. It may also be used to operate railway station facilities in a depot or other installation served by the transportation military railway service.

b. *Railway Terminal Detachment (Team EC)*. Team EC can operate a railway terminal with a capacity of 10 trains per day. No train and engine crews are included in this detachment.

c. *Railway Yard Operating Detachment (Team EK)*. Team EK can operate a large railway yard consisting of not more than two receiving and classification yards. It can also inspect and perform

minor maintenance of rolling stock in the yards. No train and engine crews are included in this detachment.

d. Railway Train Operating Section (Team EO). Team EO can operate six trains for one shift in either road or switching service.

37. Administrative Units

When the strength of TOE units is increased by the addition of supplemental teams drawn from TOE 55-500R, or by the addition of local civilian labor, or both, increases are frequently necessary in the supervisory and administrative staffs. Administrative headquarters teams will be drawn from TOE 55-500R. Mess and automotive maintenance teams will be drawn from TOE 29-500R. SR 310-30-15 contains the authorization for computation of mess and automotive maintenance personnel.

CHAPTER 9

TYPE B RAIL UNITS

38. General

The railway operating battalion and the railway shop battalion may be organized as type B units under the following TOE par. 40b) :

- a. Transportation railway operating battalion (TOE 55-225R).
 - (1) Headquarters and headquarters company (TOE 55-226.)
 - (2) Railway engineering company (TOE 55-227R).
 - (3) Railway equipment company (TOE 55-228R).
 - (4) Train operating company (TOE 55-229).
 - (5) Transportation electric power transmission company (TOE 55-217R).
- b. Transportation railway shop battalion (TOE 55-235R).
 - (1) Headquarters and headquarters company (TOE 55-236R).
 - (2) Transportation and machinshop company (TOE 55-237R).
 - (3) Transportation and smith shop company (TOE 55-238R).
 - (4) Transportation car repair company (TOE 55-239R).
 - (5) Transportation diesel-electric locomotive repair company (TOE 55-247R).

39. Mission, Assignment, and Capabilities

The mission, assignment, and capabilities of the railway operating and shop battalions type B are the same as those of the railway operating and shop battalions type A (chs. 6 and 7).

40. Organization

- a. The companies of type B battalions contain the same platoon and section structure as the companies of the type A battalions.
- b. Type B rail units are organized with the minimum number of United States military personnel required to exercise supervision over the civilian railway personnel and to insure accomplishment of the mission of the unit. Allowances of military personnel shown in the TOE may be modified by major oversea commanders to reflect local area conditions of employment or to effectively accomplish the assigned mission.

c. Comparison of the TOE for type B units with the TOE for type A units will show the jobs which must be performed by civilian personnel. The number of civilian personnel required to perform these jobs depends upon the productive efficiency of the personnel available, the number of shifts the unit works, and other local conditions. The major oversea commander or the continental United States army commander determines the number required.

d. The TOE of type B units provides sufficient equipment for the stated mission of the units. When civilian equipment such as tools and machinery is available, the full allowance of TOE equipment will not be required.

41. Management

a. The civilian personnel utilized in type B rail units should be, insofar as possible, former railway employees.

b. In an operation, due consideration must be given to the work methods and systems formerly used by the civilian railway employees.

c. Objectives must be clearly defined. A simple method of issuing orders and instructions should be devised. A detailed standing operating procedure must be established.

CHAPTER 10

CIVILIAN PERSONNEL

42. General

a. Employment. The transportation military railway service normally employs large numbers of civilian personnel. In a theater with an extensive rail net, the transportation military railway service could not accomplish its mission without utilizing them. Therefore, this chapter discusses their employment in detail.

b. Types. Civilian personnel is a general term referring to the nonmilitary and non-American persons employed or utilized by the Army from the manpower or services available in a geographic area. These civilian personnel need not be native to the country in which operations are being conducted. The two general types of labor are static and mobile.

- (1) Static employees include civilians employed within or near the area of their residence who formally were railway employees. This is the type most frequently used by the transportation military railway service.
- (2) Mobile employees include civilians employed on a long-term basis. They are organized into units, with cadre of military supervisors, and moved from place to place as required.

c. Sources.

- (1) Local employees can be hired on a voluntary basis only and employment must conform with such agreements as may exist between United States forces and local government agencies. This is the best source of local civilian personnel for the transportation military railway service. The personnel utilized are normally former railway employees and are generally native to the allied or otherwise friendly country in which United States forces are operating.
- (2) Refugees and displaced persons normally come under civil affairs—military government control. A refugee is a civilian within the material boundary of his country, but is temporarily homeless. A displaced person is a civilian who is outside the boundary of his country by reason of war.

(3) An enemy alien is a person of enemy nationality who is outside the boundaries of his country, and is in territory of, or territory occupied by, a belligerent power.

(4) Enemy nationals are civilians of an enemy power residing within the national boundaries of their own country.

d. Employment Policies. Policies for the procurement and use of civilian employees will be established by theater headquarters. Compensation and conditions of employment will also be in accordance with established policies. In allied and neutral countries, labor is voluntary as far as United States forces are concerned.

e. Relationship Between United States Forces and Civilian Employees. Every effort should be made toward attaining and maintaining good relations with, and the cooperation of, the local population. To this end United States personnel of all grades and ratings handling civilian personnel should be given extensive instruction in personnel management. The same principles of sound personnel management apply around the world; only the methods of application differ. For example, praise and fair treatment create essentially the same reaction in the mind of a Korean as in the mind of a Frenchman. Only administration varies. A hypercritical attitude can be the greatest hindrance to success in the use of civilian personnel. American supervisory personnel must consider all methods to find the best one for accomplishing a job. They must take time to examine the work of civilian personnel and to understand the reasons behind certain methods of operation in order to gain an appreciation for the accomplishment of the civilian laborer. The pattern of work in a locality should not be changed if this can be avoided. Moreover, before assuming supervisory duties, supervisory personnel should be given special indoctrination with regard to habits, customs, laws, language, religion, and the economic and political conditions in the area of operations.

43. Procurement

a. Until administration procedures have been established, civilian labor may be procured from any available source in the most expeditious and practicable manner possible by representatives designated by the commanding officers. Labor procurement during this period will be generally consistent with the principles and policies established by the theater commander in planning directives. As an example, the military railway service normally utilizes local rail organizations as rapidly as possible.

b. As the situation becomes more stable, requirements will be submitted by the using service through normal channels to the commander having territorial jurisdiction for determination of

allocation and priorities. Upon approval, the request will be routed to the proper labor agency for completion of the necessary personnel action.

44. Problems in Utilization

a. Language Barrier. The employment of individuals who do not speak English necessitates having military or civilian interpreters available in order to accomplish the job. This will probably require some additional overhead personnel and in many cases will prohibit the substitution of civilian for military personnel on a 1 for 1 ratio. One solution which may be possible is to secure a less qualified individual, one who has a reasonable working knowledge of English, and train him to perform a satisfactory job. It is also possible to hire interpreters who have supervisory ability for direct supervision of individuals working on several different jobs. They will act as liaison representatives for the regular supervisor or unit head. It should be noted that the ability to speak English does not necessarily make the individual a good supervisor or work leader. It is, however, believed more practical in general to secure individuals with the proper skills, assign them to proper positions, and through the use of a few trained supervisors, interpreters, and prepared language guides or books and/or language schools, to develop a workable understanding of the English terms which might be required to accomplish the job. Certain positions, however, require a good knowledge of the English language and are suited to on-the-job training of competent individuals.

b. Methods. There is more than one way of accomplishing a job, and the hiring of individuals to do a job for which they have the proper skill may cause certain difficulties; the United States way and the civilian way may differ. It may require tact and diplomacy to convince the individual that while the United States way is only one solution, it will be necessary to follow it because the jobs of many others who operate on the same system are affected. This does not in any way preclude the acceptance or development of new and different methods and ideas which might facilitate the operation and be of great benefit to all concerned.

c. Willingness.

- (1) The attitude of the individual has an important bearing upon the quality and quantity of work he produces. A person who likes or accepts Americans, and who is properly indoctrinated in the reasons for the necessity of accomplishing certain ends, will do a more commendable job than an individual who is working only because he must.

- (2) Unless the American has the proper attitude, immeasurable harm may be done to the attitude and willingness of the civilian worker. Proper indoctrination of military personnel can greatly facilitate the accomplishments to be attained by these workers. No indoctrination or improper indoctrination can ruin all potential benefits derived from employment of local civilian labor.

d. Habits and Customs. In many countries of the world there are habits, customs, or religious beliefs which will affect the employment of individuals in United States organizations. Certain religious holidays and festivals will cause absence of the individual as they do not necessarily coincide with the days the American forces normally observe holidays. This will cause fluctuation in the efficiency of the organization and could result in failure to fulfill work standards. National labor laws will probably have overtime or compensatory time regulations which can be used to provide sufficient personnel on these special days. In addition to the religious holidays, there are such customs as serving of tea at definite periods, siesta time during the working day, etc., which will interfere with the volume of work that can be accomplished.

45. Compensation

a. Rates and Scales. Wage scales for all types of work will normally be fixed by agreement between United States forces and the national government concerned. In the case of occupied areas, the scale will be a fair rate of pay in accordance with national legislation and the normal prevailing wage scale. The theater commander will normally publish the approved rates or scales of pay to include locality differentials, supplemental increases, night shift, holiday, and overtime rates. Because of changing conditions, it may be necessary to conduct frequent wage scale surveys to keep rates on a parity with the economy of the country.

b. Hours of Work.

- (1) The standard work day will be prescribed by the military commander in consonance, if possible, with the existing practices of the country and the needs of the military forces. In certain countries religious customs prevail to dictate the work week. For example, the Moslem religion considers Friday to be the holy day of the week. Allowances must be made for varying percentages of the work week which may be required for training.
- (2) It is not customary to employ female workers between 2200 and 0600 hours.

(3) Personnel working on special tours of duty or "on call" will not normally work more than 60 hours per week.

(4) Under wartime conditions and in war-torn areas, longer work hours may be required from civilian personnel.

c. Night Differentials. Night differentials are normally percentage increases in standard rates of pay for work performed between 2200 and 0600 hours. Generally, night differentials amount to an increase of 10 to 20 percent, depending on national practices of the country concerned.

d. Standards of Output. In order to evaluate an employee's worth for retention, it is necessary to establish standards of output. Guides to many of these standards can be secured from trade unions and industry. In other cases it may be necessary to establish these standards after sufficient time has been allowed for training of the employee and observation of his performance under existing conditions. It should be remembered that in many areas of the world, and especially where active operations have been or are being conducted, the physical condition of the employee may be substandard and his efficiency and performance will be governed accordingly.

e. Money Payments. Payment of the employee is normally in the accepted currency of the country where located. The method of payment may consist of giving items of value where the economy has become greatly inflated and the paper or metal currency has little or no real purchasing power.

f. Rations. Rations may be used as a medium of exchange in the payment of workers. They may also be provided and deducted from the pay of employees where it is desirable to use the ration as an incentive for employment, or to improve the physical condition of the employee. Normally food is a scarce and valuable item in a war-torn country and will serve to attract employees. It is customary for the United States forces to deduct the established value of the ration from an employee's pay when the payroll is prepared. The value of the ration will be established by the theater commander. The United States military ration may be undesirable because of the type of food and the eating habits of the natives, thus making it necessary to design and secure a special ration for civilian labor.

g. Other Payments in Kind. In areas where the national currency has become worthless or natives do not use money, it may be necessary to make payments in kind. In addition to rations these payments may be in tobacco, fuel, extra food, clothing, shelter, or even luxury items. In all cases the values and allowances must be established by the overall commanding headquarters of the area in

order that there will be no competitive bidding for the available labor supply.

46. Absence from Job

There are several reasons for the absence of employees from the job. These absences depend on the labor laws, labor agreements, and customs of the country.

a. Annual Leave. Employees will normally accrue annual leave after a definite period of employment. The employee may be extended the option of taking the leave or of receiving the equivalent amount of pay in lieu thereof.

b. Sick Leave. In certain countries it may be the practice to give paid sick leave with amount of time allowed based on amount of service. In other countries it is not the practice to give sick leave coverage, as there are national laws that provide for government compensation whether the employee is temporarily or permanently disabled. Normally the amount of sick leave does not carry over from year to year; nor is it the custom to pay for any that may be accrued upon separation from employment. It can be expected that employees will normally avail themselves of all compensated sick leave as it accrues.

c. Leave Without Pay. Leave without pay permits the employee to be absent for periods in excess of accrued annual and sick leave. It would appear that this type of leave is undesirable for general application although it might be advisable to extend the privilege to exceptionally outstanding employees. Labor laws of certain countries may provide that the employee be extended this privilege under certain conditions and limitations. An example which might be covered by law is maternity leave.

d. General Absence from Job. Strict policies on absence from place of employment should be established in order to provide a dependable working force. Naturally national and religious holidays will create a work-stoppage problem. When United States holidays are observed as well as native holidays, excessive absence from the job will result. All contracts and/or personnel regulations should specifically cover the subject and provide for a covering labor force for the time needed.

47. Incentives

a. Transportation. The locations of United States installations or the local transportation system sometimes necessitate that transportation be given to employees as an incentive to attract them to jobs available with United States forces. The provision of this transportation may well be the deciding factor as to whether

an individual will work for United States forces or for some local industry. Transportation for civilian personnel may be provided in one or more of the following ways:

- (1) By utilizing United States military vehicles or rail equipment and operators.
- (2) By utilizing United States military vehicles or rail equipment operated by civilian contractors.
- (3) By subsidizing a local transportation company to include provision of necessary gasoline or fuel allocations.

b. Rations.

- (1) In past operations it has been necessary to provide civilian laborers with one meal a day or a complete ration in order to attract them to employment with United States forces. The degree of devastation and the food situation in the national economy play a great part in determining just how this incentive will be provided to the employee and in what amount.
- (2) If the food supply for the nation is very critical it may be necessary to feed the individual in order that his health and well being will be adequate for performing a normal day's work. This ration incentive, although normally deducted from the man's pay, can be provided in one or more of the following ways:
 - (a) Through military messes operated by United States forces using civilian employees and food requisitioned from local economy or from United States sources.
 - (b) Through contractor-operated United States messes using United States equipment and food from local economy or from United States sources.
 - (c) Through contractor-operated messes unsubsidized by United States forces but having special privileges as far as rationed items of food or equipment are concerned.
- (3) It should be remembered that food, because of its value, will find its way into the black market and that a careful check must be kept on individuals having access to food stocks.

c. Housing. When the local area has been devastated to a high degree and the available housing for the workers is beyond reasonable transportation distance, it may be necessary to provide housing for employees in order to attract them to the job. This cost of billeting is deducted from their pay at a standard rate based upon local housing conditions. This housing will probably be of temporary type construction as determined by the climate.

d. Clothing.

- (1) Clothing in war-torn countries may be at a premium and its issuance or sale to the employee may provide the necessary incentive for work. Some working conditions make it necessary for the worker to have a good or special type of clothing.
- (2) The issuance or sale of clothing to the worker will be based upon allowances established by the theater commander who will also set up the provisions for its requisitioning through appropriate supply channels.
- (3) Strict control must be exercised over employees and stocks to keep clothing in proper channels.
- (4) Normally this clothing will be dyed a special color for control purposes.

e. Medical Care. It is not desirable to provide medical care for employees except in case of accident, when first aid and such emergency medical treatment is necessary to relieve pain, suffering, or loss of life or limb. However, in order to keep the working force in proper condition, it may be necessary to provide immunizations, vitamin pills, and at least diagnostic examinations to maintain control over contagious disease. In certain areas of the world chronic race ailments may be treated to improve the value of the employee. Provision of medical care, even if to a limited extent, is an incentive for an individual to want to work for United States forces. Actually the greatest overall medical benefit for the employee and the employers comes from improvement of sanitary conditions and preventive medicine.

f. Advancement. The giving of promotions and pay increases for exceptional work and for definite periods of service is in itself attractive to a potential employee. Such systems of promotion and pay increases must be fair and just or the attitude of the employee in the course of time will be harmed.

48. Security and Safety

a. General. Security of the military force and its operations is paramount. Care must be taken that the use of civilian personnel does not jeopardize the necessary security.

b. Identification. Proper security necessitates proper identification of an individual. The theater will prescribe the type of identification cards or passes that should be used. These identification documents are normally the responsibility of the adjutant general section to prepare, issue, and control. In many European countries civilians are required by their own laws and travel regulations to

carry extensive identification papers. It is possible that these papers, with an additional United States card or badge, would suffice for purposes of identifying the individual under some situations. In other cases it may be necessary for the employee to be photographed and fingerprinted for the preparation of some sort of laminated, tamper-proof identification card. In any event, identification documents must be closely controlled and the employee's card must be withdrawn when employment is terminated so it cannot be used for purposes which might lead to a loss of security in an agency or installation of the United States forces.

c. Screening.

- (1) Civilian employees must be closely checked by the responsible screening agency. Normally this is a responsibility of the G2 and is coordinated with the provost marshal. If enemy agents, saboteurs, or otherwise dangerous individuals are permitted to work within United States agencies or installations, the future success of the operation can be greatly endangered.
- (2) Whenever there is any question of an employee's integrity, it should be reported promptly to the responsible security agency in order to prevent possible compromise, sabotage, labor disorder, or danger to the using unit and to the United States forces.

d. Safeguarding Property. Property of all types must be safeguarded from possible theft, sabotage, or abuse. In areas of operations, many items of supply are of great value in the black market and others are susceptible to damage through carelessness and abuse. Persons hostile to the United States can sabotage our supplies and equipment and be of infinitely more value to the enemy behind our own lines than they would be firing a weapon directly into our combat positions. It is therefore usually necessary to store and move items under guard at all times to prevent loss as well as to provide proper supervision over use and handling. Actually, local civilian personnel can be used to a great extent for guarding property, if they are properly supervised and controlled. Local civilians may be used as undercover agents for our own counterintelligence and investigative agencies.

e. Counterintelligence. Counterintelligence agencies can be expected to take security control measures, both active and passive, that are designed to insure safeguarding of information, personnel, equipment, and installations against espionage, sabotage, and subversive activities of foreign agents and disaffected or dissident groups or individuals which threaten national efforts.

f. Safety.

- (1) The maximum utilization of resources is essential to efficient operation. This can be accomplished only by keeping to a minimum the manpower and monetary losses due to accidents.
- (2) The use of civilians in various positions which require United States methods, as opposed to the local methods of accomplishing a job, will increase the frequency of accidents unless a forceful safety program is instituted.
- (3) The prevention of accidents requires that the employee be forewarned of the danger or unsafe practice by instructions, signals, signs, and colors. Manual laborers who lack mental acuteness and who do not react quickly will prove to have the highest frequency accident rates because most of the work they do has more potential dangers.

g. Safety Training.

- (1) It is the responsibility of the using agency to implement safety programs and to bring to the attention of the employee, through safety training, the means and methods for preventing accidents. These training programs will have to be given and/or published in the native language of the country. This can be accomplished through military interpreters or through civilian personnel supervisors. The validity of the training program will be evidenced by monthly frequency rates as computed by higher headquarters.
- (2) This training must cover not only working safety but also recreational safety and defensive measures to be taken in case of enemy action. If the employee can utilize shelters in case of air raids and feels as secure as is possible under the situation, he will be available for work and will perform more valuable service. The civilian employee will require training for protection against chemical, bacteriological, and radiological warfare and against mass destruction weapons such as atomic and thermonuclear weapons.

49. Records and Reports

a. Employment Records. The classification, assignment, promotion, transfer, reassignment, reclassification, separation, and payment of civilian personnel are all based on an adequate set of reports and records concerning the individual employed. There is

a series of handbooks on foreign civilian labor prepared by the Office of Civilian Personnel, Office of the Secretary of the Army, showing forms, records, and reports required for controlling and administering civilian personnel. These handbooks show how to establish, operate, and staff a personnel office. In addition, each handbook gives background and operational information on the specific country or area with which it is concerned. As these handbooks have a security classification of "confidential", only units having a requirement for them should requisition these publications through normal supply channels.

b. Time Reports. Time sheets, which are records of the hours worked by each employee, are submitted by the actual using agency regardless of where the final payroll may be prepared. It is customary to have the personnel either sign in and out or punch a time clock, thus recording the hours of reporting to and departing from work. In areas where large numbers of personnel are employed en masse, it is always necessary to maintain close observation to insure that personnel are not punching or signing in for each other. In smaller types of operations it is customary for the supervisor to check and forward the time sheets or reports. In the cases of both hourly paid and salaried individuals, it is necessary to have adequate records of the amount of time worked in order to substantiate the payroll and leave records.

CHAPTER 11

TRAINING

50. General (FM 21-5)

a. Modern warfare exposes all units to potential combat. Geographical location provides no guarantee of security. Thus, it is imperative that the rail units be capable of defensive combat and of providing for security of their troops and installations. At the same time, they must be capable of performing their technical mission.

b. Unit commanders are responsible for the training of personnel in their units. Training includes individual and unit training in both military and technical fields.

c. Training must be a continuous, comprehensive effort. Its aim is to produce a smooth-running organization capable of sustained operations under varying conditions with maximum speed and efficiency. To this end, all individuals must be trained as both soldiers and technicians.

d. Coordination of training is achieved by having all training follow a standard training cycle. In this cycle, men advance successively through five phases of training, regardless of their military occupational specialty (MOS) or the type of unit to which they belong.

51. Peacetime Phases of Training (Standard Training Cycle)

a. *Basic Combat Training—8 Weeks.* During this phase, which is the first training period, the soldier is taught the fundamentals of infantry combat, including squad tactics. He also receives instruction in military skills common to all arms and services; i.e., first aid, field sanitation, and close order drill.

b. *Advanced Individual Training—8 Weeks.* During this phase the soldier trains for his MOS such as clerk, cook, draftsman, or shop foreman. Whenever service schools are available for MOS training, they should be utilized. Instruction may exceed the standard 8 weeks allowed for most MOS training. Civilian railroads are also often utilized during this period.

c. *Basic Unit Training—7 Weeks.* During this phase, trained individuals are formed into effective teams. The men learn how to work smoothly with one another. The teams learn how to operate

as components of sections or platoons, which, in turn, learn how to work together as companies. A smooth working company-size team is the end product of basic unit training.

d. Advanced Unit Training—6 Weeks. During this phase the company teams are welded into a battalion team. This period is ideally spent with the whole organization in actual operation. However, because of lack of facilities, it may be necessary for each company of the battalion to train separately.

e. Combined Arms Training Including Field Exercises and Maneuvers—5 Weeks. This phase will consist principally of field exercises. During this period, men learn valuable lessons about the capabilities and limitations of supporting arms and services. Field exercises test training accomplishments and show as nearly as possible what an active theater of operations will be like. Field exercises are also designed to accustom men to field conditions.

52. Post Cycle Training

Training does not stop with completion of the phases of the standard training cycle. Post cycle training consists of the following:

a. Refresher Training. The main purpose of refresher training is to correct deficiencies found during or after completion of the standard training cycle. For example, while on a field exercise a unit may show that it is not prepared for a gas attack—or is slow in meeting it. As soon as possible after the field exercise is over, this unit will take refresher training in defense against chemical warfare.

b. Cadre Training. The cadre for a new unit is taken from one that has already completed the standard training cycle. Since cadre men teach the new men, these cadre men must be given refresher courses in the subjects they are to teach. This training is normally an abbreviated version of portions of the standard basic and advanced individual training programs. The material, however, is presented much more rapidly and the standards of proficiency naturally are higher.

c. Training for Special Operations. Training for special operations consists mostly of additional training for extremely hot or extremely cold climate operations.

53. Training Records, Reports, and Supervision

Each unit will maintain training progress records and will submit training reports to the next higher unit. Training records maintained by the higher echelons may be unit reports of training

accomplished or consolidations of these records over predetermined periods. A sample training progress chart for a company is shown in figure 8. Each higher echelon of the transportation military railway service is responsible for supervising the training of the lower echelons. Supervision will be accomplished by inspections and tests and by analyzing training reports (FM 21-5).

54. Mobilization Phases of Training

a. General. Based on past experience, it is reasonable to assume that 85 percent of the total strength of the MRS units, ordered into active service, will have had previous and current railroading experience and will be technically qualified. The period of mobilization training encompasses approximately 20 weeks and is based on the phased availabilities and requirements for MRS. This period is subdivided into the organization, basic training, technical training, and POM phases and may be extended to a longer period.

b. Organization Phase. The organization phase will consist of a 2-week period during which these personnel will be assembled at one station, screened, and assigned to units. Assignment will be based on their previous experience and background. This phase includes travel time during which the units will move to a railway unit training center adjacent to or near suitable training facilities of a commercial railroad.

c. Basic Phase. The basic training phase will consist of approximately 8 weeks. All personnel will receive basic military training under supervision of a railway unit training center during this phase.

d. Technical Phase. The technical training phase will consist of a minimum period of 6 weeks practical, on-the-job training utilizing the facilities of a commercial railroad. The coach and pupil method will be utilized. By this method the military trainee will be paired with a civilian counterpart whose duties are similar in the MOS of the trainee. This period may be extended to include 6 months.

e. POM Phase. The POM phase will be the final phase of training and will encompass a period of 4 weeks during which preembarkation leave will be granted and the unit prepared for shipment overseas.

SAMPLE
TRAINING PROGRESS CHART

[illegible]

Figure 8. Sample training progress chart.

PART THREE
TRANSPORTATION MILITARY RAILWAY SERVICE OPERATIONS
CHAPTER 12
TECHNIQUE OF EMPLOYMENT

Section I. GENERAL

55. Comparison with United States Commercial Railway Operation

a. Although the basic principles of operation of military railways are the same as those of the railways of the United States, there are some distinct differences. Commercial railways are built and operated as commercial enterprises for the primary object of earning profits for their owners. Economy is considered in monetary terms. Competition with other carriers and the convenience of passengers and shippers are important factors. Legal requirements, restrictions, and agreements with organized labor govern operations to a large extent.

b. The above factors do not enter into the operation of military railways. Military economy is that of time, material, and manpower. Convenience is sacrificed to military necessity and legal requirements may be superseded by military necessity. Manpower is utilized to the maximum. For more details of commercial railway organization comparisons, see paragraph 7.

56. Control

a. The highest echelon of the transportation military railway service in the theater is normally assigned to the communications zone. In such cases, the communications zone commander exercises command over the transportation military railway service and the communications zone transportation officer exercises operational control.

b. Command and operational control of the transportation military railway service is not exercised by communications zone section commanders or combat zone commanders when the transportation military railway service is assigned to the communications zone.

c. Technical supervision over the transportation military railway service is exercised through technical channels beginning with the Chief of Transportation, Department of the Army, and extending down to the smallest transportation military railway service unit in the theater.

Section II. TACTICAL CONSIDERATIONS

57. General

A military force will normally use all available railways existent in the theater of operations. However, railways are very vulnerable to continued damage and destruction by hostile aircraft, guerrilla action, and sabotage.

58. Location

The location of existing railway lines may be of great strategic importance. Because long rail lines are difficult to construct in wartime, many countries have laid out their rail transportation systems with a view to employing them in military operations. Railways in the rear of the main line of resistance and parallel to it have a distinct value in the rapid movement of troops and supplies from one part of the combat zone to another. They are however, susceptible to being cut by enemy break-through.

59. Selection and Exploitation

In a theater of operations having an adequate and highly developed system of railways, it may be possible and advisable to select certain lines to exploit for military operations. Selection of the rail lines to be thus exploited will depend primarily upon strategic considerations such as probable objectives, lines of advance, frontiers, and enemy dispositions. After these have been determined, the more detailed selection of particular rail lines to be used for supply purposes becomes an operating problem to be resolved after a thorough reconnaissance of the lines (par. 128).

60. Alternate Route

After primary lines for military use have been selected, an alternate route must be devised if possible. This would be used for routing traffic in case part of the primary line is out of service as the result of enemy acts, ordinary accidents of railway operation, or washouts, landslides, storms, and floods.

Section III. TECHNICAL CONSIDERATIONS

61. Classification

Railways are classified by gage—standard, broad, or narrow. More than half the total railway mileage in the world is 4 feet 8½ inches, which is known as standard gage. Broad gages include 60-, 63-, and 66-inch gage. Narrow gages include 42-, 39¾- (1 meter), 36-inch, and smaller.

62. Desirable Physical Characteristics

a. The following are important considerations when selecting railways for military use:

- (1) Proper location of terminal, yard, and shop facilities.
- (2) Single, double, or multiple track.
- (3) Seasoned roadbed, good ballast, and heavy rail.
- (4) Light grades and curvature.
- (5) Adequate yards, sidings, spur, and other tracks.
- (6) Bridges of sufficient strength and clearance for military loads.
- (7) Tunnels of sufficient clearance for military loads.
- (8) Loading and unloading facilities where needed.
- (9) Short mileage between important points. (This is subordinate to the other characteristics enumerated, but must be given consideration if the mileage of a first-class line is much in excess of that of a secondary line properly located for military use.)
- (10) Water supply points 30 miles or less apart and fuel supply points 85 miles or less apart if steam motive power is to be used in road service.

b. Adequate terminal facilities are vital. Regardless of all else, the line will become congested, the equipment supply frozen, and plant facilities useless if the cars cannot be and are not unloaded and returned promptly. An increase in terminal capacity can be secured often by adding tracks and vehicular roads to permit unloading either by hand or mechanically.

63. Undesirable Physical Characteristics

When selecting railways for military use, care should be taken to decide upon those roads which have the least number of vulnerable points for possible interruption to traffic. The decision

must be consistent with tactical requirements. These potential bottlenecks, which are vulnerable to enemy action or natural forces, are—

a. Tunnels.

b. Long, high bridges or bridges over deep, wide streams.

c. Deep cuts and high fills.

d. Terminals so situated or constructed as to become congested. (This difficulty may be overcome in certain cases by construction of a bypass for through traffic.)

e. Track located immediately adjacent to banks of streams and dry washes subject to the erosive action of rushing water during floods.

f. Restrictive clearance points.

64. Facilities

a. Loading and Unloading.

- (1) For the loading and unloading of supplies and impedimenta, railways must have certain facilities such as spur, house, team, and yard tracks; platforms; end and side loading ramps; cranes; hoists; and pipelines for loading and unloading inflammable liquids.
- (2) Personnel, light vehicles, and light artillery usually can be loaded at any railway station. Heavy trucks, materiel, and equipment require special loading and unloading facilities. When not available, they must be constructed.
- (3) The number and character of the loading facilities required will be dependent entirely on the quantity, size, and character of the materiel to be moved.

b. Track.

- (1) *Siding.* A siding is a track adjacent to a main track, connected by switches at each end. Sidings are normally used for the passage or meeting of trains. Military railway trains vary from 1,600 to 2,400 feet in length and sidings should be of sufficient length to accommodate the longer trains. If sidings are used for entraining and detraining, they should be long enough to handle the entire train so that there will be no interruption to traffic on the main line. However, when the situation so demands, main lines, sidings, and any other available facilities may be used. It is important that loading and unloading points selected be easily accessible to adjacent highways.

- (2) *Spur track.* A spur track diverges from a main or branch line to serve an industry. No regular train service is maintained over it. A spur track is usually connected to the main line or siding at one end only by a switch. The other end is a stub or dead end.
 - (3) *Team track.* A team track is a sidetrack on which freight cars are placed for loading or unloading from and to other modes of transportation.
 - (4) *House track.* A house track is a track alongside or entering a freight house used for cars receiving or delivering freight to the house.
 - (5) *Industrial track.* An industrial track is a track serving one or more industries.
 - (6) *Yard track.* A yard track is any track of a system of tracks within a prescribed area used for storing or classification of cars and making up or breaking up trains. Such an area with its system of tracks is called a yard. A large terminal may contain one or more receiving, classification, outbound, storage, switching, and repair yards.
- c. *Entraining or Detraining Points and Areas.*
- (1) The term entraining or detraining point is used to designate the particular place at which troops are to be loaded or unloaded. Large railway stations may have two or more suitable entraining or detraining points; at smaller stations there may be only one.
 - (2) An entraining or detraining area is an area which includes all of the entraining or detraining points.
 - (3) A train is considered to have left the entraining area when it has passed the forward entraining point in that area.

65. Use of Existing Facilities

(ch. 28)

a. Existing trackage and facilities are utilized and exploited to the fullest extent. Construction of new main track in the theater of operations is avoided whenever possible. However, at times new facilities must be provided and existing facilities adjusted to meet the conditions of war. These facilities include yards, rail side-tracks, fuel and water stations, signal systems, including telephone and telegraph lines, and enginehouses.

b. As the army advances, captured enemy lines will be rehabilitated as required. Availability for immediate service, rather than

permanency, will be the controlling factor in the type and character of rehabilitation.

c. The following general regulations will govern the construction or rehabilitation of facilities in a theater of operations:

- (1) *Yards and sidetracks.* Care must be exercised in the location and plan of track layouts to secure facilities required by current military operations and future needs. In their construction or rehabilitation, necessity governs. The general track surface should be good enough to meet immediate requirements. It is improved only when needed to meet minimum requirements for safe operations.
- (2) *Water and fuel stations.* Water and fuel stations in a theater of operations will consist of any suitable facilities which are available or which can be adapted or improvised.
- (3) *Signals, telephone, and telegraph.* The signal system on new or rehabilitated lines will be of the simplest kind. Automatic block signals and interlocked switches may be used and maintained when already in existence; however, they are easily sabotaged. A crossing may be protected by a manually operated gate. A telegraph office may be provided with a manually operated train order board or flag. Train dispatching is preferably accomplished by telephone because of its greater dependability and simplicity. Dispatching by telephone has an added advantage—by equipping isolated sidings with a telephone box for use of train crews, movement of trains is frequently facilitated in emergencies. When existing telegraph lines are taken over wholly for military use, it is advantageous to convert them to telephone lines.
- (4) *Enginehouses.* The roundhouse with its usual adjunct, the turntable, may have to be avoided in any area subject to bombardment by enemy aircraft because of the ease with which it can be recognized from the air. New enginehouses should be simple, rectangular, frame structures without complicated doors or windows. Provision should be made for turning locomotives on wyes. In cases in which a roundhouse or turntable is part of existing facilities taken over for military use, precautionary measures should be taken to insure that locomotives will not be cutoff and rendered useless in case the turntable is disabled.

Section IV. PHASES OF OPERATION

66. General

a. Railways in a theater of operations are normally utilized to the fullest extent. In an ever-expanding theater, the problem of supplying skilled personnel to operate and maintain military railways becomes acute. This problem may be resolved by the use of civilian personnel skilled in the peacetime operation of the railway net.

b. Trains for civilian needs and military trains up to a certain distance from the front may be operated by civilians, but military trains beyond that point will be operated by railway troops. Details of such operation are worked out jointly by military and civilian authorities. Trains used for military purposes have priority over those carrying civilians or civilian goods, but the needs of the civilian population must be considered.

c. During World War II, as military railway operations proceeded from points of invasion into the interior of a theater of operations, the trend of operation and control soon gave evidence of a definite pattern. This pattern was characterized by three phases of rail operations: military, military-civilian, and civilian with limited military supervision.

67. Phase I

a. Phase I operation of military railways is conducted exclusively by military personnel. It is normally instituted in combat areas for the following reasons:

- (1) Civilian assistance cannot be depended upon for preplanning purposes.
- (2) Positive obedience to orders is essential to effect control and operation of railways in combat areas. This is gained through use of railway troops under a unified command.
- (3) Security of military operations in forward areas is imperative.
- (4) Civilians should not be subjected to combat conditions according to rules agreed upon by several nations at the Geneva Conference.
- (5) No language difficulties are encountered.

b. Military railway operations by troops will exist whenever military necessity is the governing factor. Where civilian or joint operation fails to satisfy military requirements, military railway troops will take over the operation.

68. Phase II

a. Phase II operation of military railways is conducted jointly by military personnel and by civilian personnel under direct military control. It is normally instituted in the forward areas of the communications zone. Phase II is merely a transitory phase of operations, but it is desirable because—

- (1) Some civilian railway employees may be restored to their jobs, thus aiding local economy.
- (2) Increased rail transport capability may be achieved. This would permit the operation of some civilian trains.
- (3) The transition from military (phase I) to the civilian (phase III) rail operations is accelerated.

b. Phase I or II rail operations may be retained indefinitely on a primary rail route from a port to the combat zone if it is critical to the military operations in progress. Thus, if there were only one port available for the logistical support of the combat forces, it should be retained under phase I or II operation until such time as additional ports and rail routes become available.

69. Phase III

a. Phase III operation of military railways is conducted by civilian railway personnel under military control with a minimum of military supervision. It is normally instituted in the rear areas of the communications zone for the following reasons:

- (1) Railway troops are released for employment in forward areas.
- (2) Additional civilian railway employees are restored to their jobs.
- (3) Increased rail transport capability is achieved. This normally permits the operation of additional civilian trains. However, the needs of the military are given first priority.

b. Phase III operation is normally in effect when supervision and implementation of train dispatching and movement are restored to the civilian railway operators. Depending upon the military situation, phase III operations may be instituted immediately upon entry into a theater.

c. In phase III rail operations the procedures for train movement used and understood by the local civilian rail operators should be adopted. Most foreign countries operate trains only on time-table schedules. The superimposing of military trains upon existing civilian train schedules requires careful planning by officers of the transportation military railway service.

d. Before instituting a phase III operation, local civilian operators should be adequately organized. They must be made thoroughly familiar with military requirements for transportation, points of contact, bilingual car documentation, and car ordering procedures. All pertinent bilingual transportation documents should be prepared before the changeover.

CHAPTER 13

RELATIONSHIP WITH OTHER AGENCIES

70. General

a. Tact and cooperation are essential in all dealings between personnel of the transportation military railway service and other agencies or military commands. In the field the railway groups and operating battalions come closer to the actual users of transportation than do the general headquarters, transportation military railway service, and railway commands. Thus the railway groups and operating battalions are able to help rail users solve many transportation problems.

b. Operation of trains is a function solely of the transportation department of the transportation military railway service. Operational safety prohibits interference by other personnel.

71. Higher Headquarters

The placement of railway group headquarters and the railway operating and shop battalions will logically come in natural sequence as the theater develops. However, the deployment of such units will have to be coordinated with G3 of the command to which assigned, through the staff transportation officer. Often conditions will arise in which more than one rail route is essential in a campaign, and the choice will entail coordination with G4 of the command to which assigned and a joint reconnaissance with the Corps of Engineers. At times such matters may have to be handled at theater army level. In addition, the general manager, or one of his assistants, looks after certain special rail moves which are sponsored from time to time by higher headquarters.

72. Communications Zone Section

For administrative purposes railway operating and shop battalions come under the jurisdiction of the communications zone sections. The section commanders retain area responsibility over these units including courts-martial jurisdiction, financial transactions, hospitalization, supply of items of common usage, and certain phases of personnel accounting. Under this arrangement the rail battalions receive, from other technical services in the same section, food and clothing from the Quartermaster Corps;

medical treatment from the Army Medical Service; repairs to organic unit vehicles, weapons, and watches from the Ordnance Corps; chemical protective items of equipment such as protective masks from the Chemical Corps; railway supply material and assistance from the Corps of Engineers; and communications equipment from the Signal Corps.

73. The Arms

The principal contact the transportation military railway service will have with the Infantry, Artillery, and Armor will be with the arms in the role of users of rail transportation. However, the arms are frequently employed to provide security for trains and rail lines (ch. 19).

74. Other Services

a. General. The transportation military railway service cooperates with and assists other services whenever possible. For instance, the railway group and operating battalion often help the services in locating dump and depot sites, even sending reconnaissance teams for such purposes as far forward as the combat zone. They locate rail sidings for hospital units to load and unload the wounded. The operating battalions assist in handling heavy lifts with their locomotive cranes. Although set up primarily to repair standard railway equipment, the railway shop battalion may coordinate its efforts with other organizations in making emergency repairs. Such repairs cover work on stationary boilers to fit a building for a hospital; refitting landing ships, tank, to carry railway rolling stock, welding railroad rails on tanks to break down roadblocks; and many other jobs.

b. Corps of Engineers. The construction, rehabilitation, and major maintenance of military railways is the responsibility of the Corps of Engineers (AR 55-650). Transportation military railway service's plans for such work will be coordinated with the Corps of Engineers. When required, the transportation military railway service will furnish technical assistance to the Corps of Engineers.

c. Signal Corps. The Signal Corps is responsible for the construction and rehabilitation of wire circuits required for train dispatching and the administration of military railways, as well as certain maintenance responsibilities (par. 103). Transportation military railway service's plans for such work will be coordinated with the Signal Corps.

d. Military Police Corps. The provost marshal is responsible for planning and supervising the physical security measures when military police units are detailed for guard duty or civilian guard personnel are employed to provide for the security of supplies in transit. The operation of each security unit must be completely coordinated with the operations of adjacent security units and the transportation military railway service. See chapter 19.

e. Army Medical Service. Transportation military railway service train maintenance units service and maintain ambulance trains both at stabling points and en route. Operating battalions provide steam, water, electrical, and latrine facilities for ambulance trains at stabling points. The transportation military railway service coordinates with the communication zone surgeon in selecting stabling points and the actual scheduling of ambulance trains as well as in the other work listed.

f. Quartermaster Corps. The Quartermaster Corps is responsible for cleaning of the interiors of railroad petroleum tank cars. This cleaning will be performed at Quartermaster petroleum storage depots and coordinated with the military railway service.

75. Other Transportation Corps Agencies

a. Staff Transportation Officer. The commander of the highest echelon of the transportation military railway service in a theater will be the direct adviser to the staff transportation officer of the command to which assigned on all matters pertaining to railway operation in the theater. He advises the staff transportation officer of the rail transportation capabilities, and the transportation officer determines what use will be made of these capabilities in the movement program. He keeps the transportation officer informed of any factors that may seriously affect the programmed movement of supplies. He furnishes the transportation officer railway information, intelligence, plans, operating reports, and supply estimates as required. The railway command staff coordinates with the proper staff sections of the transportation officer.

b. Field Transportation Officer. A field transportation officer will be located at each important shipping and receiving point. He arranges with the local transportation military railway service station agent or representative for the furnishing and placing of cars and for the transportation of personnel and supplies. He is responsible for the receipt and storage of less-than-carload shipments pending their delivery to the consignee. He operates transfer points, consolidating facilities, and in-transit storage facilities (FM 55-10).

76. Civilian Agencies

It is the responsibility of the transportation military railway service to effect coordination of rail operations with civilian railway agencies. This is particularly important when preparing to institute phase II operations as the transportation military railway service will control the civilian operation of military railways during phase III operations. Coordination with civilian rail authorities normally begins with the start of military railway operations and ends only when United States forces leave the theater. Since the main effort of coordination is at the highest echelon, transportation military railway service personnel are in close contact with the highest civilian railway authorities—presidents, vice presidents, and department heads, with the president often holding cabinet rank.

CHAPTER 14

RAILWAY MOVEMENT PROCEDURES

77. Use of Equipment

a. Effective and adequate military railway support of military operations in a theater requires efficient use of railway rolling stock and motive power.

b. Officers responsible for loading and unloading cars must supervise closely to see that railway rolling stock is promptly released. Transportation military railway service representatives and field transportation officers must work in close coordination. They must be decisive in their actions to facilitate prompt loading, unloading, and release of rolling stock.

c. Passenger equipment is frequently limited to use in leave trains, military casual personnel trains, and ambulance trains. Organized troop movements such as replacements or TOE units are handled in freight equipment if passenger equipment is not available.

d. Special equipment includes specially designed rolling stock for handling unusual weight or size lading, railway work equipment, and ambulance cars. When standard Department of the Army ambulance cars are not furnished in a theater of operations, passenger equipment found in a theater may be converted by the transportation military railway service for ambulance use.

e. When feasible, refrigerator and tank cars are handled in solid trains from origin to destination and return on a high movement priority.

78. Control by Higher Headquarters

a. The communications zone transportation officer normally exercises control over the movement by rail of troops and supplies within, out of, and into the communications zone. The theater army transportation officer normally exercises control over the allocation and utilization of rail equipment used in the movement of troops and supplies within the combat zone. The theater army transportation officer may delegate all or part of this authority to the communications zone transportation officer.

b. The movement control division of the transportation section of a command usually has a passenger and freight branch (fig. 9).

These branches receive and assemble the requirements for rail transport, arrange with the transportation military railway service to accomplish the necessary movement, and insure that such movements are in accordance with established priorities.

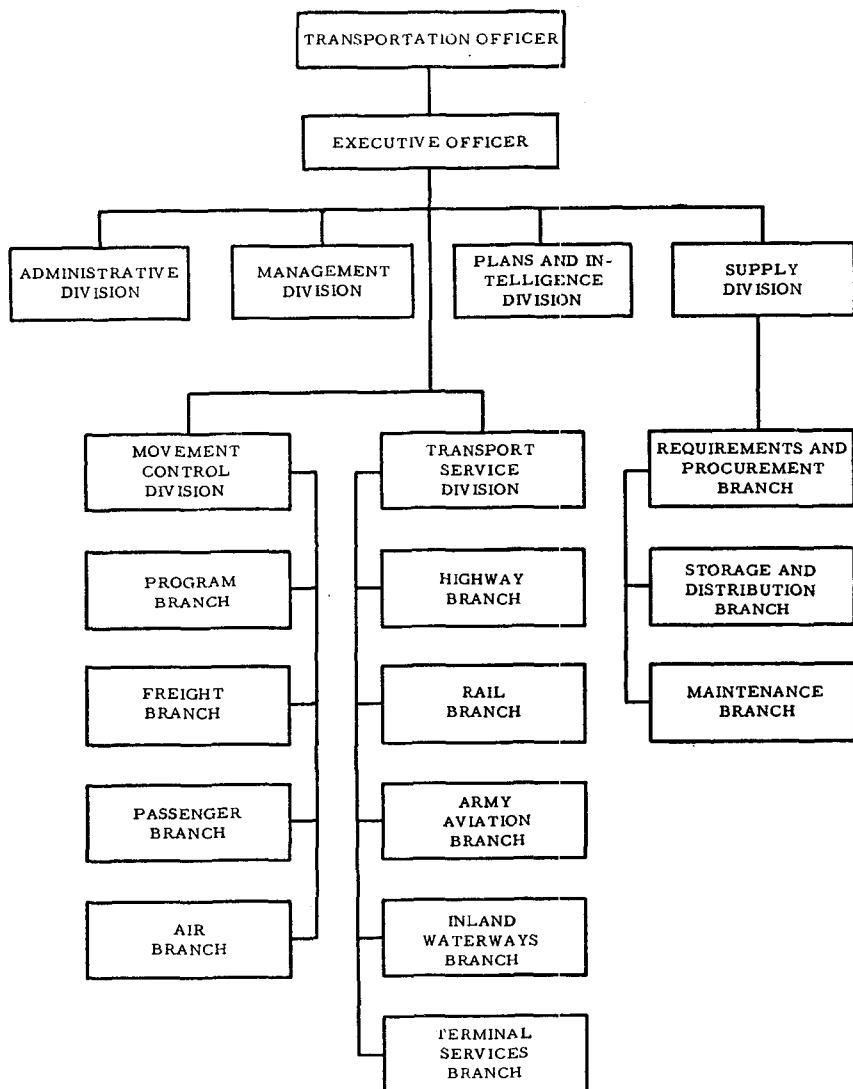


Figure 9. Type transportation staff organization.

79. Personnel Movements (FM 55-10)

a. *General.* Troop movements usually create an unusual demand for rolling stock. A lead time of not less than 3 days should be allowed in ordering this equipment. Normally, troop movements will be made from selected entraining areas, generally in

the vicinity of a troop staging or training area, so that rail facilities required for supply movements will not be congested. Where troop movements in freight equipment involve long distances, coordination must be effected to select and schedule stopover points for messing and relief of the troops while en route. For large troop movements, movement control personnel will, when possible, spread the departure time over several days in order to minimize the concentration of equipment. Thus the same equipment may be used several times in a shuttle movement.

b. Authorization for Rail Travel.

- (1) Normally the communications zone transportation officer receives the information on troop arrivals in the theater and on troop movements into, within, and out of the communications zone. Based on priorities established by the communications zone commander, the communications zone transportation officer prepares a troop movement program which is issued by the communications zone commander. This program is a directive for the accomplishment of troop movements during a specified period of time.
- (2) The commanding general of a theater of operations has authority to issue travel orders covering rail movements of individuals and units and their impedimenta. Normally this authority will be delegated to subordinate commands. No statement showing procurement authority is necessary; the official order directing the movement is sufficient.

c. Troop Movement Procedures. The normal procedure for troop movements by rail is as follows:

- (1) Orders directing the movement are delivered to the field transportation officer.
- (2) The field transportation officer obtains the following information and transmits it to the passenger branch, movement control division, office of the communications zone transportation officer:
 - (a) Authority for the move.
 - (b) Number of personnel.
 - (c) Point of origin.
 - (d) Destination.
 - (e) Date of departure or date due at destination.
 - (f) Amount of baggage and/or impedimenta.

- (3) The passenger branch contacts the operation section of the railway command and together they arrange the following details:
 - (a) Route.
 - (b) Schedule.
 - (c) Quantity and type of equipment.
 - (d) Time and place of entrainment.
 - (e) Transfer points, if required.
 - (f) Place and time of detrainment.
 - (g) Messing facilities, if required.
 - (h) Rest stops, if required.
 - (i) Medical care en route.
- (4) The passenger branch assigns a MAIN number to identify the movement and transmits details of the itinerary to the field transportation officer through movement control channels.
- (5) The operations section of the railway command transmits details of the itinerary to all transportation military railway service agencies concerned and assures that the rail equipment is made available when required and that the train or trains are operated as scheduled.

80. Supply Movements (FM 55-10)

a. Authority for Movements. Authority for the movement of supplies by rail is obtained from the following:

- (1) *Supply movement program.* The supply movement program is a directive normally prepared by the communications zone transportation officer and issued by the communications zone commander for the accomplishment of supply movements during a specific period of time. This program is the means by which shippers, receivers, and transport services are advised of movement priorities, designated transport services, and scheduled movements. It enables them to make preparations to accomplish the movements at the time and in the order specified. Supply movement programs are also prepared by communications zone section transportation officers and issued by the section commanders. These programs are concerned only with that portion of transport capabilities allocated to the sections.
- (2) *Movement instructions.* Transportation officers of subordinate commands normally implement movement programs by issuing movement instructions to transport services, to shippers, and to receivers concerned with movements. The instructions assist personnel by provid-

ing information not contained in the movement program or by clarifying information already included in the movement program. Movement instructions are also issued concerning nonprogrammed movements.

- (3) *Transportation Corps release.* The Transportation Corps release is the authority issued by the movement control organization (through the field transportation officer to shippers and transport services) to accomplish a specific shipment within a stated period of time from a specific origin to a specific destination using a specific means of transportation.

b. Ordering Cars. Ports, technical service depots, and other shipping agencies place their requirements for rail cars through their local field transportation officer or, when authorized, the local railway operating representative, a minimum of 24 hours before loading time. This will afford a more economical use of rolling stock and switch engines in the car spotting and switching operations involved. Requirements for rolling stock over and above that authorized by the movement program as prepared by communications zone and section transportation officers must be authorized by the transportation officer concerned, except in extreme emergencies.

c. Loading Cars.

- (1) Cars must be loaded by the using agency to maximum capacity within safe tonnage or space limitations.
- (2) Icing of cars and blocking and bracing of loads must be effected by the using agency. Inspection of lading of open-top cars will be made by transportation military railway service personnel as to safety for movement. For documentation information see paragraph 85.
- (3) A large percentage of foreign cars are designed for uniform floor loads. Where concentrated loads such as Army tanks are to be transported, care must be exercised to furnish the proper type of cars.
- (4) When it is necessary to use side loading ramps for heavy equipment, personnel must arrange to load such equipment so that car deck and floor sills will not be damaged. Such equipment should be rolled onto the car at or near the center of the car truck and then moved toward the center of the car. In some cases it may be necessary to reinforce the car flooring.
- (5) Where loading approaches or exceeds the size of the average boxcar in the area, clearance standards for the route to be traveled must be checked.

CHAPTER 15

RAILWAY TRAFFIC MANAGEMENT

81. General

Traffic management functions pertinent to rail operations in a theater of operations are important to effective and efficient movement of supplies and personnel by rail. Technique and reports incident to these functions must be adequate, yet simple, so that they do not become more important than the rail operations in progress.

82. Distribution of Rolling Stock

Distribution is intended to accomplish the following:

- a. Reduce empty car movements to a minimum.
- b. Control movement of empty cars through the rail net in order to fulfill the requirements of loading agencies.
- c. Forecast unusual and peak loading requirements and furnish cars accordingly.
- d. Distribute cars in short supply in accordance with priorities established by G4 through the transportation officer.
- e. Prevent abuse in the use of cars; for example, holding cars under load as a rolling reserve or not loading cars to capacity.
- f. Control flow of empty cars to various terminals to prevent traffic congestion.

83. Car Records

a. Car records provide quick and ready references to the location or movement of any item of rolling stock at any time. In a theater of operations these records should be established as quickly as possible after rail operations are instituted.

b. Throughout the railway system there may be several car records offices which are generally located at large yards or terminals. There is usually at least one such car records office on each railway division. However, depending on the local situation, the railway group may designate one car records office for two or more divisions.

c. Records may be maintained for empty as well as loaded cars. However, car records of empty equipment need not be kept in all situations.

d. A common ledger-type book with pages numbered from 0 to 99 may be used as a car record book. The last two digits of a car number indicate the page of the book upon which it will be entered.

Where train symbols (par. 87) are used, the symbol is sufficient identification for the car location. Reference to the train consist of that symbol number, filed in the car records office, will furnish all other information. If train symbols are not used, the train number and the date on which it was received or forwarded must be shown.

84. Train Documentation

a. To document trains, all loaded cars or designated equipment are listed on a prescribed form, normally DA Form 55-223, Conductor's Wheel Report. The following information is shown for each car: car number, type of car, a brief statement of contents of car, weight, origin, destination, and train identifying number or symbol (par. 87).

b. A document, or train consist, is prepared at the point of origin. It is prepared by the yardmaster or his representative after the train is made up in the yard and is ready to go. Four copies are required, to be distributed as follows:

- (1) The original—to car records office for posting of records and filing.
- (2) One copy—to field transportation officer at train origin.
- (3) One copy—retained by yardmaster at train origin.
- (4) One copy—to yardmaster at train destination.

c. Train consists are kept in current files for approximately 30 days and then placed in permanent files for use when financial accounting becomes necessary with the owners of the rail lines operated by the transportation military railway service.

d. In the event a bad order car is set out at a way station, the train conductor should note this fact on his wheel report. He notifies the train dispatcher who will take necessary action to have the car repaired. The conductor of the train subsequently picking up this car will enter that action on his wheel report. The train dispatcher will notify the car records office which train picked up the car so that a proper record can be made.

85. Car Documentation

a. Car documentation provides a method of identifying loaded cars or other specified equipment. The document, when delivered to the transportation military railway service, is authority for the transportation military railway service to move the car. No car should be moved, except in emergency, unless it is accompanied by a car document.

b. DA Form 55-224, Freight Waybill is the car document normally used in transportation military railway service operations. In addition to special information required by other agencies and special movement instructions, the freight waybill shows the car

initials, number, contents, weight, date, consignor, consignee, point of origin, and destination. The waybill is prepared by the shipper or the field transportation officer and at least one copy will accompany the car.

c. In some transportation military railway service operations, 3- by 5-inch card waybills have been used satisfactorily, in addition to freight waybills. Two card waybills were prepared for each car and one card waybill fastened to each side of the car. This minimized delays due to lost waybills. The card waybills were of various markings and colors—yellow for Quartermaster supplies, red for Engineer supplies, etc. This aided in ready identification of cars during switching operations in terminals and railheads.

86. Daily Installation Situation Report (DA Form 1322)

a. In addition to special reports that may be required, one essential routine report is required in transportation military railway service traffic management functions. This report, DA Form 1322, daily installation situation report, also aids in proper car distribution. Figure 10 shows a sample copy of this report. This form will be requisitioned through normal AG publications supply channels.

b. This report is prepared at a specified time each day by transportation military railway service personnel at all stations, railheads, yards, terminals, and other points where loading, unloading, or car movements activities are in progress. It is so designed and coded that it may be transmitted easily by telephone, teletypewriter exchange, or radio. It is consolidated at each level of command in battalion, group, and command.

c. The report is used along with other reports to determine the effectiveness of transportation military railway service operations in meeting tonnage commitments. It is also used by car distributors and car service superintendents at all levels of command to anticipate and meet daily loading requirements and to forecast shortages of rolling stock. With this information they can regulate, systemwide, the flow of cars to the various loading points.

d. Preparing agencies will furnish a copy of this report to the field transportation officer in their area.

87. Train Symbols

a. As an added means of identifying trains, train symbol numbers may be used in addition to scheduled train numbers or extra train numbers. Extra train numbers normally change on each division but it is possible that two scheduled trains with the same number would be on the line on the same date.

b. An example of a train symbol number is M-10-4-95. Following is the derivation of each symbol in the number:

- (1) M=The point of origin; for example, M for Marseille. If more than one route is being used, a second letter can be added indicating the route; for example, MA for a train originating at Marseille and running over route A.
- (2) 10=The day of the month the train departed from its initial station.
- (3) 4=The number of the month.
- (4) 95=The numerical position of the train in the total number of trains operated during the month.
- (5) Therefore, in the example given above, the train originated at Marseille, departed from Marseille on 10 April, and was the ninety-fifth train forwarded from Marseille during April.

c. Train symbol numbers are issued by the train dispatcher on the division where the train originates. A central register of train symbols may be maintained at railway group or command headquarters to show location of trains while in transit. Division dispatchers will report the progress of the trains as they clear each division.

d. If records on empty cars are not maintained, symbols will not be assigned to empty trains.

88. Solid Shipments

In a large theater of operations it is desirable to move military trains loaded with one item of supplies such as gasoline, ammunition, or rations. They also may be loaded with various items of a single service such as Quartermaster or Engineer class II and IV supplies. Thus, when a train reaches its destination, the entire train may be delivered to a siding assigned for the use of one service. However, trains may be mixed with cars for delivery to two or more services.

89. Tracing and Expediting

a. A consignee may be anxious about the fulfillment of a certain requisition. If the consignor has already shipped by rail, the consignee needs only to refer the car number to the nearest station agent. The station agent will contact the car records office which can furnish the train symbol number. From this number the railway group or command can give a location report.

b. In the event certain classes of supply such as gasoline or ammunition become critical in the combat zone, the transportation officer will call on the railway command to determine the location of trains with these supplies on the rail system and authorize priority for their movement over all other trains.

CHAPTER 16

RAILWAY OPERATING PROCEDURES

90. Establishment of Rail Operations

a. Establishment of railway operations on a newly captured or liberated railway in the combat zone is a difficult task. It will normally be accomplished in the following sequence:

- (1) First step—movement to and concentration of rail units in the objective area. Normally, this will be accomplished in three echelons—
 - (a) Advance party.
 - (b) Main body.
 - (c) Rear echelon.
- (2) Second step—reconnaissance of the assigned rail line(s). Personnel for the reconnaissance party should be selected with great care. The reconnaissance should produce sufficient intelligence to determine the characteristics of the rail line, condition of existing facilities and equipment, and availability of civilian railway personnel (pars. 59 and 128).
- (3) Third step—evaluate the capabilities and limitations of the rail line(s) (ch. 23).
- (4) Fourth step—determine method of operation to be employed (par. 91) and issue necessary special instructions.
- (5) Fifth step—orient subordinate rail units on the characteristics of the rail line(s) and the operation thereof.
- (6) Sixth step—deploy subordinate rail units.
- (7) Seventh step—establish a working relationship with the various transportation officers concerned and the various shippers and receivers.
- (8) Eighth step—initiate rail operations.

b. Many of the above functions in the objective area may be accomplished concurrently. Limited rail operations will often be instituted within a few hours after rail personnel become available in the area.

91. Methods of Operation

a. Existing railway facilities found in a theater will be operated as required to support the military operations in progress. It may normally be expected that communications and railway signaling,

including any form of centralized traffic control, electrically operated interlocking plants, and automatic block signaling, will be damaged, destroyed, or inoperative. Automatic block signaling is easily sabotaged and may become a serious hazard to the safe movement of trains.

b. The methods by which trains are operated in a theater include fleet, manual block, train order, and timetable operation—or a combination of these. When the method of operation has been decided, the actual operation will be carried out in accordance with railway operating rules as provided in FM 55-56 (par. 92).

- (1) *Fleet operation.* This method of operation is used primarily during the early stages of military railway operations, before the establishment of rail communications and the construction or rehabilitation of rail sidings. Basically, fleet operation entails the movement forward of only loaded trains during one period (4 hours, 8 hours, 12 hours, or 24 hours) and the return movement of only empty trains during a succeeding like period. Limitations inherent to this method of operation are the capacity of the forward terminals and the decrease in locomotive and car utilization.
- (2) *Manual block operation.* This method of operation is used before the completion of a dependable rail communications net. In order to move a train from one block into the next the train movement operator must obtain permission from the train movement operator in the station next in advance of the train and also the dispatcher, if possible. The two types of block operation are permissive and positive (absolute) (FM 55-56). In permissive block operation, more than one train may occupy the same block. In positive block operation, a train may not enter a block that is already occupied by another train. Positive block operation is used on rail lines subject to frequent guerilla attack, enemy action, or sabotage since it allows a train to back up to the nearest station when the track is blocked. Most foreign countries use the block method of operation.
- (3) *Train order operation.* This method of operation is used when adequate and dependable communications and adequate sidings are available. Under train order operation the train dispatcher controls train movement by issuing train orders to the trains in compliance with rules contained in FM 55-56. He issues them orally,

by telephone or radio, through train movement operators. The train movement operator writes the orders as received and repeats them back to check their accuracy. Operation by train order is efficient and flexible. Meets can be arranged and/or changed, and rights conferred or reversed, to expedite train movements.

- (4) *Timetable operation.* This method of operation is not used until rail traffic in the theater becomes more or less stabilized. A timetable is the authority for the movement of regularly scheduled trains, subject to the rules (FM 55-56). A timetable contains classified schedules of trains with special instructions relating thereto. Extra trains are not listed on the timetable. Military railway train operation in a theater of operations may consist entirely of extra trains with no regularly scheduled trains. However, timetable operation is normally used in conjunction with train order or manual block operation to afford flexibility.

92. Operating Rules

a. Train operation is governed by FM 55-56. This manual is based on the Standard Code of Train Rules issued by the Association of American Railroads. The rules have been modified to apply to conditions found in a theater of operations.

b. The correct interpretation, proper application, and observance of these operating rules are of primary importance in the efficient and safe operation of a military railroad.

c. Commanding officers of personnel whose duties are prescribed or regulated by the rules contained in FM 55-56 will provide each individual with a copy and will be responsible for the observance of the rules.

93. Types of Trains

Two general types of trains, classified by the nature of their cargo and, in some instances, their equipment, are—

a. *Passenger Trains.* Through passenger trains are used to move passengers, express, and mail on long runs. Local passenger trains operate on a slow schedule, making frequent stops at small stations.

b. *Freight Trains.* Through freight trains handle cars between terminals and over long distances on a fast schedule. Local freight trains handle local and short haul freight. Work and wreck trains do not carry passengers or freight. Their purpose is to provide equipment and material for railway workmen.

94. Operation of Ambulance and Other Special Trains

a. Ambulance Trains.

- (1) *Priority.* An ambulance train takes priority over all other trains except trains being run under emergency conditions for the express purpose of supporting a force in actual combat.
- (2) *Immunity.* Red Cross markings are displayed in accordance with the Geneva Conventions agreements, which affords the train immunity from enemy action. This agreement also states who may ride ambulance trains (normally noncombatants); enforcement rests with the theater commander.
- (3) *Limits of operation.* The limits of ambulance train operation are normally from a railhead in the army area to a port or to an intermediate hospital.
- (4) *Authorization (FM 100-10).* The communications zone surgeon initiates the request for requirements and movement of ambulance trains. The location of stabling points will be selected by the communications zone surgeon in coordination with the transportation military railway service.
- (5) *Operation (FM's 55-22 and 55-60).* The transportation military railway service is responsible for the movement and maintenance (par. 33) of ambulance trains. Schedules are prepared by the transportation military railway service to meet the requirements of the surgeon.
- (6) *Standard ambulance cars.* Standard ambulance cars consist of the following types. These cars may be run individually or in any required combination.
 - (a) Ward car—accommodates 30 patients.
 - (b) Medical personnel car—accommodates 15 attendants; 4 officers, and 2 nurses.
 - (c) Kitchen, dining, and storage car—seats 25 persons.

b. *Other Special Trains.* Other special trains include the following. They are operated as required.

- (1) Ration trains.
- (2) Leave trains.
- (3) Refugee trains.
- (4) Prisoner of war trains.
- (5) Special trains for civilian purposes.
- (6) American Red Cross trains.

95. Speed of Train Movement

In most cases trains are operated at slow or moderate speeds in a theater of operations. Arrival at destination is the primary consideration. When experience factors are not available, military train operation is planned at an average speed of 8 miles per hour. Maximum speed in forward areas is generally limited to 20 miles per hour.

96. Yard and Terminal Operations

a. In general usage, a yard is a system of tracks used in the breaking up, classifying, storage, and making up of trains. A terminal includes, in addition to yard tracks, repair and servicing facilities and facilities to accommodate railway train crews. Yards will normally be located at ports, interchange points, large depots, and forward railheads. Terminals are normally located at originating and terminating points of trains, and at sites which mark the limits of the operating divisions.

b. In a yard or a terminal consisting of one yard, specific tracks are designated for the purpose of receiving inbound trains, others for classification of cars, and others for outbound trains. However, a terminal may consist of one or more yards and may contain yards for the following purposes:

- (1) *Receiving or inbound yard.* The main purpose of this yard is to get trains off the main line.
- (2) *Classification yard.* In this yard trains are broken up and classified according to commodity and destination.
- (3) *Outbound or forwarding yard.* After trains are classified they are placed in this yard to be made ready for their departure.

c. In addition to the three yards listed above, a terminal may contain the following special purpose tracks or yards:

- (1) Storage tracks or yards where freight cars are stored either loaded or empty awaiting orders from using agencies.
- (2) Coach tracks or yards used for passenger equipment and with facilities for heating, icing, and making light repairs to passenger equipment both in and out of service.
- (3) Repair tracks and yards where freight and other types of rolling stock are repaired.
- (4) Stock tracks and yards provided for feeding, resting, and watering livestock. They are also used to transfer stock from one car to another if a car is "bad ordered" en route.

- (5) Industrial tracks used exclusively for one shipping agency.
- (6) Team tracks accessible by truck for the purpose of loading or unloading from rail cars by more than one agency.
- (7) Scale tracks used for weighing cars.
- (8) Shop tracks used in connection with repair yards, roundhouses, and backshops.
- (9) Engine tracks used to store engines awaiting service.
- (10) Cab tracks used to store cabooses awaiting service.

97. Assignment of Motive Power and Rolling Stock

a. Road Engines. Road engines are assigned to operating divisions on the basis of the number and type of trains to be operated, the physical characteristics of the division, and the available water, fuel, and servicing facilities.

b. Switch Engines. Switch engines are assigned to yards and terminals on the following bases:

- (1) Ports and depots—1 per 67 cars dispatched and received per day.
- (2) Railheads—1 per 67 cars dispatched and received per day.
- (3) Intermediate yards and terminals—1 per 100 cars passing or handled per day.

c. Rolling Stock. Rolling stock, except work equipment, is not assigned to one division, but is used over the entire system. Work equipment is assigned to operating divisions as required.

98. Safety Rules

a. Safety rules, applicable to transportation military railway service personnel in the performance of their duties, are published in WD Pam 55-1. It is required that every member of the transportation military railway service familiarize himself with these rules and obey them.

b. Special instructions will be issued to supplement WD Pam 55-1 to cover the unusual situations that may be encountered.

99. Interruptions to Rail Traffic

a. General. Major interruptions to rail traffic must be reported without delay through channels to the communications zone transportation officer in order that he may make the required adjustments in the movement program. The transportation military railway service is responsible for clearing up all interruptions as quickly as possible. Assistance may be obtained, when required, from the Corps of Engineers and the Signal Corps and by use of available civilian personnel.

b. Major Causes of Interruptions.

- (1) Enemy action, including aerial bombing, artillery, and guerilla activity. Principal targets are bridges and tunnels.
- (2) Man failure which includes improper train operation and improper inspection and maintenance of equipment.
- (3) Equipment failure.
- (4) Natural causes including floods, rockslides, and snowslides.

c. Types of Interruptions and Corrective Action.

- (1) *Major derailments.* If a fire starts, undamaged equipment should be pulled away from the fire. Clearing operations should be conducted from both ends of the derailment. Traffic should be diverted from the interrupted line to an alternate line if possible. In double track territory, one track must be cleared first and single track operation instituted. A rail-truck transfer point should be set up if required.
- (2) *Minor derailments.* Minor derailments may be cleared by use of car rerailers or jacks. If it is necessary to avoid delay to critical traffic, derailed cars may be rolled clear of the main track. Locomotives may be used to push or pull cars clear of the main track. Wreck trains should not be used unless necessary.
- (3) *Washouts.* Action to be taken where washouts are likely to occur should be preplanned. Repair materials should be stockpiled at suitable locations. Personnel may be transferred from one train to another by walking around the washout. Rail-truck-rail transfer for supplies is feasible and may be required.
- (4) *Tunnel cave-ins.* If possible, a collapsed tunnel should be "daylighted" by excavation. If "daylighting" is not feasible, a bypass should be constructed. The use of alternate rail lines should be considered. A rail-truck-rail transfer may be required.
- (5) *Guerilla action.* Damage by guerillas may be expected and will require continuous checking to prevent derailments or other interruptions.
- (6) *Congestion at yards and terminals.* To maintain fluidity, yards and terminals should not be filled beyond 60 percent of static capacity. Embargoes may be required as a last resort.

(7) *Other possible causes of interruptions.*

- (a) Lack of adequate communications.**
- (b) Lack of alternate rail lines.**
- (c) Lack of proper operating supplies and/or equipment.**
- (d) Misuse of rolling stock.**
- (e) Fires and explosives.**
- (f) Language barrier.**
- (g) Failure of temporary bridges or improvised construction.**
- (h) Restricted clearances.**

CHAPTER 17

RAILWAY MAINTENANCE

100. General

- a. For railway construction, see chapter 28.
- b. In the early phase of an operation, maintenance standards will be such as opportunity permits. Arbitrary safety rules become secondary to military necessity and the mission.
- c. As the situation stabilizes and conditions permit, maintenance standards will be higher in order to minimize accidents, insure dependable train operation, and increase line capacity.

101. Maintenance of Way and Structures

a. *General.* The railway engineering company of the railway operating battalion performs routine maintenance of way and structures. Maintenance standards will be prescribed by the engineering section of the highest echelon of the transportation military railway service in the theater. (See FM 55-22, TM 5-370, and TM 5-627 for a complete description of maintenance functions.) The Corps of Engineers is responsible for the construction, rehabilitation, and major maintenance of military railways (AR 55-650).

b. *Materials.* Maintenance and emergency repair materials must be stockpiled in proper quantities at strategic points along the rail line. Inspections must be made to prevent over and under stocking and to see that materials are stacked properly and free of fire hazards.

c. *Roadway Maintenance.* This includes work performed on the following:

- (1) Drainage system (ditches, culverts).
- (2) Cuts and fills.
- (3) Subgrade.
- (4) Ballast.

d. *Track Maintenance.* This includes work performed on the following:

- (1) Gage.
- (2) Surface.
- (3) Alinement.
- (4) Switches.

e. Structural Maintenance. This includes work performed on the following:

- (1) Bridges.
- (2) Culverts.
- (3) Tunnels.
- (4) Fueling facilities.
- (5) Watering facilities.

102. Maintenance of Equipment

a. General. Railway equipment found in a theater of operations will be utilized to the greatest extent feasible. Normally a great deal of maintenance is required on such equipment. This equipment will be supplemented by United States Army equipment which has been standardized. (See FM's 55-22 and 55-60 for a description of the Transportation Corps standard fleet.) Maintenance standards will be prescribed by the equipment section of the highest echelon of the transportation military railway service in the theater. Technical details of the inspection and maintenance of steam locomotives and cranes, diesel-electric locomotives, and rolling stock will be found in TM's 55-270, 55-271, 55-285, 55-289, 55-290, and the operating and maintenance manuals issued for each type of diesel-electric locomotive. Technical details concerning the operation of locomotive shops will be found in TM 55-274.

b. Echelons of Maintenance. (See FM's 55-22 and 55-60 for inspections and work required under each echelon of maintenance.) In general, the unit responsible for each echelon of maintenance on rolling stock and motive power is as follows:

- (1) First echelon—railway operating battalion.
- (2) Second echelon—railway operating battalion.
- (3) Third echelon—rear areas, railway operating battalion; forward areas, railway workshop (mobile).
- (4) Fourth echelon—railway shop battalion.
- (5) Fifth echelon—railway shop battalion.

c. Maintenance of Ambulance Cars. The unit responsible for each echelon of maintenance on ambulance cars is as follows:

- (1) *First echelon.* Interior cleaning performed by the Army Medical Service personnel stationed aboard the train. All other first echelon maintenance performed by ambulance train maintenance crews while en route and by the ambulance train maintenance section while at stabling points.
- (2) *Second echelon.* Ambulance train maintenance section.

- (3) *Third echelon.* Ambulance train maintenance section, assisted by the railway operating battalion when required.
- (4) *Fourth echelon.* Railway shop battalion.
- (5) *Fifth echelon.* Railway shop battalion.

103. Installation and Maintenance of Signals and Communications

a. General. The railway engineering company of the railway operating battalion performs maintenance of railway signals, signal lines, and the communications lines reserved for the exclusive use of the transportation military railway service. Maintenance standards will be prescribed by the signals and communications engineer of the highest echelon of the transportation military railway service in the theater. Technical details of maintenance of railway signals and communications will be found in TM 55-205, chapter 4.

b. Railway Signals. The transportation military railway service is responsible for the installation, operation, and all maintenance of railway signals, interlockings, and centralized traffic control (AR 55-650). The Corps of Engineers is responsible for the construction and rehabilitation of primary electrical power sources and transmission lines from these sources for the operation of railway signaling systems.

c. Railway Communications.

- (1) The need for adequate and dependable railway communications in the theater of operations is concurrent with the requirement for a railroad. The operations of the railway system, the movement of trains, and the functions incident thereto—extended over several hundred miles of track—are dependent upon communications. Rail capacity is directly related to the efficiency of the communication system.
- (2) The communication system for railway operation normally consists of two physical circuits and one simplex circuit.
 - (a) *Train dispatcher's circuit.* This circuit is used exclusively for train movements by train order and for control of trains through towermen and station agents within a division. It is extended to the adjacent division dispatcher's office, providing this office is located at the beginning of the adjacent division. It consists of the selective ringing type voice circuit on one of the physical pairs. The dispatcher may call each way station independently or all stations simul-

taneously. The division dispatcher monitors the line at all times with a loudspeaker or headset. The way stations may talk to the dispatcher without signaling on this circuit. The equipment layout is shown in figure 16.

- (b) *Station-to-station circuit.* This circuit is required for "block line" operation within a division and is used for operational supervision and control, daily and special reports, car distribution, dissemination of movement orders to operating personnel, and train movements and operational matters between way stations. This is a manual, local battery, code-ringing, party line voice circuit on the other physical pair and is sometimes called the message circuit. The way stations are connected to each other and to the division dispatcher; thus each station agent or operator may contact any other station or the dispatcher through code signaling.
- (c) *Teletypewriter circuit.* This is a simplex leg of the message circuit connecting adjacent division dispatchers' offices. It is used for the written transmission of train consists, operational orders, movement programs, general instructions, and miscellaneous messages.
- (3) When land lines are inoperable, the Signal Corps will provide radio communications on a class IV basis when approved by the theater commander (AR 55-650; TM 55-205, par. 44).
- (4) The Signal Corps is responsible for the construction and maintenance of communications systems for military railways, except when all circuits along a military railway line are turned over to the transportation military railway service for its exclusive use. The circuits will then be maintained by the transportation military railway service (AR 55-650).
- (5) The transportation military railway service is responsible for the installation and maintenance of organizational communications (except cryptography) with TOE equipment within headquarters of railway groups, battalions, and lower echelon units (AR 55-650).

CHAPTER 18

RAILWAY SUPPLY

104. General

a. Railway supplies, as distinguished from organizational supplies, are technical supplies required for the operation and maintenance of railways. See FM 55-22 for organization supply details.

b. Although just as important, military railway storekeeping is not as complicated as that of United States commercial railways for the following reasons:

- (1) Many of the items used by commercial railways to provide for the comfort and convenience of the public are not needed in military operation.
- (2) Military railways do not practice the same high degree of maintenance necessary on commercial railways.
- (3) Military railways use fewer types of motive power and rolling stock.
- (4) Military railways have standardized a great number of items.

105. Transportation Depot Companies

a. The basic organization for supply in the Transportation Corps is the transportation depot company. Its mission is to provide for the receipt, storage, and issue of all Transportation Corps items of supply and equipment. The supervisory echelons of the transportation military railway service do not stock stores and supplies; therefore, when required, the transportation depot company may be assigned to the transportation military railway service and handle railway supplies exclusively. When assigned to the transportation military railway service, the depot company can be used to operate a central railway stores depot and/or subdepots (par. 106).

b. When assigned to the transportation military railway service, the transportation depot company is assigned to the railway command. The assistant general manager, supply, exercises full control over the stores and supplies in the depot. He will process and approve requisitions and will be responsible for the maintenance of supply levels in the depot. He may authorize the supply officers in the lower echelons of the transportation military railway service to requisition certain items of routine supply directly

from the depot or subdepot without the approval of the next higher headquarters.

106. Railway Stores Subdepots

a. Railway stores subdepots are normally located at points where they can support the routine requirements for operating and maintenance supplies of two to six railway divisions. The subdepots may stock all types of fuel, lubricants, locomotive and car parts, tools, machines, bridge and track materials, and railway signaling and flagging equipment.

b. The value of such subdepots lies in the reduction of the quantity of stock in numerous local shops, storerooms, and roadway track sections throughout the rail net. By uniform use of standard stocks, and with adequate communications, operating and maintenance supplies can be quickly distributed to meet operational requirements.

107. Procurement

In a theater of operations, railway supplies may be procured from the sources given below. (Whenever possible, local sources of supply should be exploited in order to ease the demand on transportation from the zone of interior.)

a. Military stocks available in the theater which are normally replenished from commercial sources in the zone of interior.

b. Manufacturing or producing firms in foreign countries which may be near or in the theater of operations.

c. Local civilian and foreign railway stocks and railway supply channels.

d. Captured enemy material and equipment.

e. Parts and assemblies manufactured or repaired by the railway shop battalions.

f. Transfers between railway operating battalions.

108. General Requisitioning Procedure

a. The normal procedure for requisitioning a transportation item of supply is as follows: The company commander submits a request to the battalion supply officer. The battalion supply officer consolidates requests where necessary, prepares a formal requisition, and forwards it to the railway group supply officer. The supply officer of the railway group determines if there is an excess of the item or items requested in one of the other units assigned to the railway group. If so, the transfer will be made from one battalion to the other. If not, he processes the requisition and forwards it to the assistant general manager, supply, of

the railway command. The assistant general manager, supply, may then direct the transfer of the requisitioned supplies from one railway group to another. If the items are not found in excess of current requirements in another railway group, he passes the requisition to the transportation depot company for issue.

b. In cases where the railway group is the highest echelon of the military railway service in the theater, the supply officer of the railway group discharges the responsibilities of the assistant general manager, supply.

c. In cases where the railway operating battalion is not operating as a part of a railway group, the battalion supply officer is normally authorized to handle supply matters directly with the supply agencies.

109. Obtaining Supplies from Military Sources

a. *Supplies from Military Stocks.* Normal requisitioning is in accordance with the procedure outlined in paragraph 108. However, the railway command assistant general manager, supply, may authorize the battalion supply officers to requisition certain transportation items of routine supply directly from the transportation depot or subdepot without the approval of the next higher echelon. Items in short supply may be controlled as necessary, depending on the stock level in the depot. The battalion supply officer also may be permitted, by the same headquarters, to requisition routine supplies from supply services other than Transportation Corps directly from the depots concerned.

b. *Parts and Assemblies Manufactured or Repaired by the Railway Shop Battalion.* Railway operating battalion company commanders submit informal requests or work orders to the battalion supply officer who forwards them to the railway group. The railway group may authorize the railway operating battalion supply officer to deal directly with the railway shop battalion supply officer.

c. *Transfers between Railway Operating Battalions.* Company commanders submit requests to the battalion supply officer. The battalion supply officer forwards the requests to the railway group supply officer or, if required, prepares formal requisitions and forwards them to the railway group.

110. Obtaining Supplies from Other Sources

a. *Supplies Purchased from Foreign Civilian Sources.* Company commanders submit requests to the battalion supply officer. The battalion supply officer prepares purchase orders or requisitions in accordance with the policy established in the particular theater.

Normally the purchase orders or requisitions are forwarded through channels to the railway command for processing and approval. However, the railway operating battalion commander may be delegated the authority to approve purchase orders and requisitions for certain quantities of particular supplies. In such cases, the battalion procures the supplies locally and sends information copies of the transaction through channels to the railway command.

b. Supplies Obtained from Local or Foreign Railway Stocks or Through Local Civilian Railway Supply Channels. All supplies obtained from this source, including those on hand at the beginning of operations, are reported currently by company commanders to the battalion supply officer. The battalion supply officer forwards the information through channels to the railway command. The assistant general manager, supply, will redistribute such supplies where necessary. It is essential that accurate records be maintained of all such transactions in order to protect the United States Government from fraudulent claims.

c. Captured Enemy Material and Equipment. All major items of captured enemy material and equipment must be recorded and accounted for. In order that these supplies may be properly recorded and distributed, company commanders report such items of equipment obtained from this source to the battalion supply officer who forwards the information through channels to the railway command.

111. Railway Fuel and Lubricants

Allotments of coal and other fuels for locomotives are normally made by a control board in the zone of interior for each theater of operations conducting large scale operations. This item of supply is of such importance and usually of such volume that it receives special attention and handling. The fuel agents assigned to each supply section in the various military railway service echelons of command are responsible for seeing that the operating agencies of the military railway service actually receive sufficient locomotive fuels regardless of source. Requisitions for fuel and lubricants will be made through normal channels.

112. Stocking and Stock Levels

a. The preparation of tables of allowances and tables of supplies for units within the military railway service is the function of the supply officer in the highest military railway service echelon of command. These tables must be prepared, with an appreciation of operation in general and on the basis of requirements

of specific operations, by each division of railroad and each backshop. A workable stock level allowance must be determined for each unit to insure uninterrupted operations at all times.

b. Authorized allowances for spare parts for United States Army locomotives and rolling stock are contained in DA Supply Manuals TC 7, 8, and 9, "C" and "L" series (Organizational, Field, and Depot Maintenance Allowances and List of All Service Parts). These manuals list the estimated quantities of spare parts to be used as a guide by maintenance organizations in stocking such parts, based on requirements for 90 days of maintenance.

c. DA Supply Manual TC 4-R1 (Allowances of Expendable Supplies for Rail Organizations) prescribes basic allowances of expendable supplies not otherwise authorized. It supplements tables of organization and equipment and tables of allowance for rail organizations. The quantities of supplies listed in TC 4-R1 represent the maximum that should be on hand at any one time.

- (1) The stock numbers of expendable items authorized by TC 4-R1 should be checked, when preparing requisitions, against similar items in DA Supply Manual TC 3-2 (List of Current Issue Items, Expendable Items). Corrected and up-to-date stock numbers are contained in TC 3-2.
- (2) Certain items authorized in TC 4-R1 must be ordered by code number as well as stock number. Code numbers may be found in DA Supply Manual TC 5-1 (List of All Items—Stock List).

d. Supervision must be exercised by supply officers at all echelons to insure that the required stock levels are maintained and that supplies are distributed properly throughout the railway system. Accumulation of excessive stocks must be prevented. Whenever such conditions are found, the excess supplies will be redistributed as required or returned to depots.

CHAPTER 19

RAILWAY SECURITY

113. General

a. In a theater of operations, the security of Government supplies and equipment is of extreme importance. Usually the normal government and law enforcement agencies are either nonexistent or ineffective.

b. Military action causes much destruction and confusion in cities, in ports, and along lines of communication. In addition, military operations require logistical support which often exceeds the normal capacity of the existing ports, lines of communication, and supply installations. These demands necessitate the use of temporary and improvised facilities, thus increasing the problems of safeguarding cargo, equipment, and installations.

c. All of these factors contribute to vandalism, pilferage, and black market activities. Guerilla activities, sabotage, and hostile air action further add to the loss of supplies and equipment and to the degree of vigilance required.

d. This chapter deals primarily with the security of railway installations, equipment, and rail shipments which are responsibilities of the transportation military railway service. Purely military aspects of rear area defense and security are responsibilities of area and unit commanders. The military aspects of the following as they pertain to military railway units, are discussed in FM's 55-22 and 55-60: guerilla operations, sabotage, infiltration, air attacks, atomic attack, airborne attacks, rear area defense, area damage control, and chemical, biological, and radiological defense.

114. Responsibility for Security

a. Security is a function of all levels of command. The protection or safeguarding of Government property is the responsibility of every officer and enlisted man in the military establishment.

b. Combat and communications zone area commanders are responsible for the security of their areas including defense against enemy air or ground attack, and against sabotage of lines of communication, installations, and Government property.

c. The transportation military railway service security responsibility for supplies, troops, mail, and other cargo moving by rail

begins when the loaded cars are coupled to an engine or train for movement. This responsibility ends when the loaded cars are delivered to a designated depot, siding, or track (FM 55-22).

d. Shippers are responsible for proper loading, blocking, bracing, closing, sealing, icing, and documenting of rail cars. They are responsible for the security of loaded cars until properly turned over to the transportation military railway service. Consignees assume responsibility for the security of loaded cars at the time they are delivered at the designated depot, siding, or track (FM 55-22).

115. Security Personnel

a. Military railway units do not have adequate organic personnel to provide necessary security without hampering their primary mission of operating and maintaining a military railway. It is necessary, therefore, to call upon higher headquarters for the assistance of antiaircraft artillery, military police, and other units needed for the protection and security of trains and rail installations.

b. In accordance with the needs of the rail battalions and railway operation, the highest echelon of the transportation military railway service will request required units through the staff transportation officer. Such units will normally be placed in direct support of the battalions.

116. Security of Supplies Moving by Rail

a. An essential element in effecting adequate security for railway shipments is an adequate system of documentation and records (ch. 15). Proper loading and sealing of cars and prompt loading and unloading will aid materially in reducing pilferage.

b. Military police units, attached or assigned to the transportation military railway service, provide train guards for cars and trains en route and for cars and trains which are in the process of movement in rail yards. When bad order cars are set out, a member of the guard crew will remain with the car until properly relieved. Guard crews will check car seals and documentation and will be particularly alert for cars that are loaded in a manner to make pilferage easy. Train guard reports of cars or trains guarded, showing any deficiencies or action taken, are included in documentation necessary for security.

117. Security of Installations

Security of static installations such as tunnels, bridges, yards, and shops against enemy air or ground attack and sabotage is the responsibility of the area commander. For the guarding of such

installations, military police or other guard units may be provided by the rear area defense commander upon request. However, interior guard for unit bivouacs is provided by the transportation military railway service units.

118. Security of Trains Against Enemy Air or Ground Attack

a. Ground Attack or Guerilla Warfare. Occasionally it is necessary to operate and maintain rail lines in areas subject to partisan activity or where depredations may be expected from small enemy units. This is particularly true in areas where pockets of resistance have been bypassed during rapid advances and mopping-up operations have not been completed. In such situations, any of the following actions may be necessary.

- (1) Armored trains may be used for patrolling track in open country in hostile territory when depredations may be expected. Armored trains, usually attached to armies or sections of the communications zone, operate tactically under orders of the appropriate military commander. The officer in command of the train is in command of the garrison and directs movements of the train in combat; however, he must coordinate movements with the transportation military railway service representative when movements of other trains are involved. Since the operation of an armored train is quite different from that of other trains, the transportation military railway service will assign a specially selected train crew.
- (2) In situations where combat troops are not available for the protection of the lines of communication, it may become necessary for railway operating units to organize their own defense of trains, rail lines, critical bridges, and tunnels until such time as other supporting troops become available. This will result in a reduction in the number of trains operated or defer routine track, bridge, or equipment maintenance.
- (3) Railway gondolas may be quickly prepared for railway defense by piling sandbags on the floor and at the sides and mounting machine guns, mortars, and rocket launchers. At least two such cars per train are required. These cars must not be placed next to cars containing gasoline, ammunition, or other inflammables.
- (4) Locomotives should be placed so that two or more cars loaded with sandbags or scrap material are ahead of them for protection against mines and obstructions.

- (5) On single track rail division subject to ground attack, the positive block method of operation should be invoked. In this method of operation a following train is not permitted to enter a block until the preceding train has cleared the block. This permits the train in the block, if attacked, to back up if necessary.
- (6) The primary mission of train personnel and combat or security troops is to get the train through to destination. As long as this mission is being accomplished and the train continues to move, control of the train remains with the train crew. However, if a fire-fight develops and the train is unable to disengage by movement forward or backward, the senior combat member present will take command and undertake defense of the train with all personnel available. In such areas, radio communications should be furnished in order to call for assistance.

b. Enemy Air Attack.

- (1) Defense against hostile air action is conducted by anti-aircraft artillery units supporting the train. Antiaircraft guns are mounted on cars spaced throughout the train as required. Due to the length of normal trains and the short time available to organize defense, it is not possible for the train crew to man these guns effectively.
- (2) Trains that are attacked by enemy aircraft should continue to move if possible; however, when visibility is poor and the characteristics of the rail lines are favorable, it may be possible to conceal the train in tunnels, deep cuts, or heavily wooded areas. Steam engines are more difficult to conceal than diesel engines.

119. Demolition

a. The transportation military railway service may be charged with responsibility for demolition of railway facilities and equipment that cannot be evacuated during retrograde operations. The implementation of such demolition may be undertaken only upon orders of the proper tactical commander. Actual demolition may be performed by the railway battalions (FM's 55-22 and 55-60). The assistance of engineer demolition teams may be requested.

b. The extent of demolition to be accomplished is based on the tactical commander's concept of the situation and is divided into two classes—

- (1) Total destruction of locomotives, rolling stock, track, structures, and facilities is undertaken when the situa-

tion is such that the facilities and equipment will be of no further use and the territory lost is not expected to be recovered for an extended period of time. Total destruction should only be implemented as a last resort.

- (2) Immobilization of equipment and facilities by removing and saving essential and similar parts of locomotives and rolling stock and partial demolition of selected bridges or tunnels will temporarily deny the use of tracks, equipment, and facilities to the enemy when it is expected that the lost territory will be regained in a relatively short period of time. The fact that the enemy may completely destroy the equipment and facilities upon his retreat is a calculated risk which must be accepted.

c. Units of the transportation military railway service will maintain current demolition plans for each class of demolition to indicate the following:

- (1) Company and unit teams responsible for implementing demolition plans.
- (2) Quantities of demolition materials required and locations at which stored. (See FM 5-25 for computation of explosive requirements.)
- (3) Alert plan to implement demolition.

d. Demolition and alert plans will be consolidated by the railway group and railway command and coordinated with the proper transportation officer or tactical commander.

CHAPTER 20

RECORDS AND REPORTS

120. General

a. The records and reports discussed in this chapter are confined to those pertaining to the administration, maintenance, and operation of military railways. The majority of these reports are originated by the operating and maintenance units and forwarded through channels to the highest echelon of the transportation military railway service. At each echelon reports will normally be consolidated. The consolidated report will be forwarded to the next higher echelon. In some cases, only information extracted from consolidated reports will be forwarded to the next higher echelon.

b. Most transportation military railway service reports are completed at a prescribed time or date and a time schedule is set up indicating the time or date the reports are due at each echelon. Reports will be forwarded by telephone, teletype, mail, or messenger, as directed.

c. Transportation military railway service records and reports are necessary for the efficient administration, operation, and maintenance of military railways and to supply information requested by the transportation officer. They reflect the progress of operations and maintenance, the current situation, and the required statistical information.

d. Reports and records prepared or received are considered as unit permanent records and will be properly safeguarded until disposal instructions are issued by the highest echelon of the transportation military railway service. Disposal will be in accordance with AR 345-200 and theater standing operating procedures.

e. Records and reports should be kept to a minimum. The records and reports listed in paragraphs 121-124 are numbered forms that are available and unnumbered recommended records and reports. No attempt should be made to utilize all of the listed records and reports, but only those that are essential.

121. Train Operation and Traffic Management

a. Numbered Records and Reports. (Asterisk indicates sample form in FM 55-56.)

- | | | |
|------|-----------------|---|
| (1) | DA Form 55-95 | Tank Car and Heavy Duty Flat Car Movement Report |
| (2) | DA Form 55-102 | Car Record Book |
| (3) | DA Form 55-165 | Conductor's Report of Damaged or Defective Cars |
| (4) | DA Form 55-200* | Clearance Form "A" |
| (5) | DA Form 55-203* | Train Order |
| (6) | DA Form 55-205 | Dispatcher's Record of Train Movements |
| (7) | DA Form 55-206 | Combined Register of Trains and Comparison of Watches |
| (8) | DA Form 55-208 | General Notice |
| (9) | DA Form 55-209 | Station Record of Train Movements and Operator's Transfer |
| (10) | DA Form 55-210* | Check of Train Register |
| (11) | DA Form 55-211 | Yardmaster's Call Report |
| (12) | DA Form 55-212 | Switch List |
| (13) | DA Form 55-214 | Superintendent's Telegraphic Report of Accidents |
| (14) | DA Form 55-215 | Transportation Corps, Military Railway Service, U. S. Army; Instructions (to be pasted on inside of front cover of Bulletin Book) |
| (15) | DA Form 55-216 | Daily and Cumulative Report of Train Tonnage |
| (16) | DA Form 55-220 | Time Inspection Register |
| (17) | DA Form 55-221 | Time Record of Standard Clock |
| (18) | DA Form 55-222 | Set Out Report |
| (19) | DA Form 55-223 | Conductor's Wheel Report |
| (20) | DA Form 55-232 | Mechanical Examination for Locomotive Engineers Questionnaire |
| (21) | DA Form 55-242 | Daily Telegraphic Car Report |
| (22) | DA Form 55-243 | Daily Statement of Cars on Hand |
| (23) | DA Form 55-250 | Request for Car Movement |
| (24) | DA Form 55-266 | Battalion Fuel Situation |
| (25) | DD Form 472 | Train Guard Trip Report |

b. Unnumbered Records and Reports.

- (1) Daily installation situation report (par. 86).
- (2) Dispatcher's operational report (FM 55-22).
- (3) Personnel movement report (FM 55-22).

- (4) Rail line interruptions (other than train accidents) (FM 55-22).
- (5) Personal injury report (FM 55-22).
- (6) Special reports (as required).

122. Inspection and Maintenance of Track and Structures

a. Numbered Records and Reports.

- (1) DA Form 55-253 Bridge Inspection Report
- (2) DA Form 55-256 Telegraphic Report of Obstruction to Line
- (3) DA Form 55-258 Report of Material on Line

b. Unnumbered Records and Reports.

- (1) Construction and reconstruction progress report (FM 55-22).
- (2) Track inspection report.
- (3) Tunnel inspection report.
- (4) Coal, fuel, and water station inspection report.
- (5) Pole line inspection report.
- (6) Signal inspection report.
- (7) Telephone drop inspection report.
- (8) Personal injury report (FM 55-22).
- (9) Special reports (as required).

123. Inspection and Maintenance of Locomotives and Locomotive Cranes

a. Numbered Records and Reports. (Asterisk indicates sample form in TM 55-270).

- (1) DA Form 468* Unsatisfactory Equipment Report.
- (2) DD Form 865 Daily Assignment Worksheet for Locomotives and Locomotive Cranes.
- (3) DA Form 55-150* Ash Pan and Spark Arrester Inspection and Repair Record.
- (4) DA Form 55-151* Alteration Report for Steam Locomotive and Locomotive Crane Boilers.
- (5) DA Form 55-152* Boiler Specification Card for Steam Locomotives and Locomotive Cranes.
- (6) DA Form 55-167 Inspection Report for Steam Locomotives and Steam Locomotive Cranes.
- (7) DA Form 55-202* Locomotive Equipment, Supply and Tool List.

- (8) DA Form 55-226* Daily Inspection Report Locomotives and Locomotive Cranes.
- (9) DA Form 55-227* Monthly Inspection and Repair Report.
- (10) DA Form 55-228* Annual Inspection and Repair Report, Steam Locomotives and Locomotive Cranes.
- (11) DA Form 55-230* Monthly Inspection and Repair Report of Locomotives and Locomotive Cranes Other than Steam.
- (12) DA Form 55-234 Daily Report of Terminal Blow-down Operations.
- (13) DD Form 862 Daily Inspection Worksheet for Diesel-Electric Locomotives.
- (14) DD Form 864 Annual Inspection Worksheet for Diesel-Electric Locomotives.
- (15) DD Form 863 Monthly and Semi-Annual Inspection Worksheet for Diesel-Electric Locomotives.
- (16) DD Form 438-1 Railway Equipment Report—Motive Power Other Than Steam—Part I—Registry, Assignment, and Service Record.
- (17) DD Form 438-2 Railway Equipment Report—Special Equipment, Locomotive Cranes—Part I—Registry, Assignment, and Service Record.
- (18) DD Form 438-3 Railway Equipment Report—Motive Power (Steam)—Part I—Registry, Assignment, and Service Record.
- (19) DD Form 438-5 Railway Equipment Maintenance (Exclusive of Rolling Stock).

b. Unnumbered Records and Reports.

- (1) Daily backshop progress report (FM 55-60).
- (2) Daily enginehouse progress report (FM 55-22).
- (3) Report on new motive power placed in service (FM 55-22).
- (4) Report of damage to motive power involved in accidents (FM 55-22).
- (5) Accident and personal injury report (FM 55-22).
- (6) Special reports (as required).

124. Inspection and Maintenance of Rolling Stock

a. Numbered Records and Reports. (Asterisk indicates sample form in TM 55-285.)

- | | |
|----------------------|--|
| (1) DA Form 468* | Unsatisfactory Equipment Report. |
| (2) DA Form 55-126* | Request and Receipt for Spare Parts, Supplies, Services, or Repairs for US Army Hospital Cars from the Pullman Co. or Railroads. |
| (3) DA Form 55-154* | Record of Special Tests Made on Air Brake Equipment. |
| (4) DA Form 55-155* | AAR Defect Card. |
| (5) DA Form 55-156* | Battery Removal and Application Record. |
| (6) DA Form 55-158* | Hospital Car Inspection and Repair Record. |
| (7) DA Form 55-160* | Record of Cleaning Water Tanks on Hospital and Kitchen Cars. |
| (8) DA Form 55-161* | Air Brake Defect Tag. |
| (9) DA Form 55-162* | Inspector's Record. |
| (10) DA Form 55-163* | Car Inspector's Train Report. |
| (11) DA Form 55-164* | Bad Order Tag. |
| (12) DA Form 55-165* | Conductor's Report of Damaged or Defective Cars. |
| (13) DA Form 55-168 | Inspection Report for Railway Cars. |
| (14) DA Form 55-237* | Passenger and Freight Car Specification Card. |
| (15) DA Form 55-241* | Report of Cars Damaged. |
| (16) DD Form 438-4 | Railway Equipment Report—Rolling Stock, Cars—Part I—Registry, Assignment, and Service Record. |
| (17) DD Form 438-5 | Railway Equipment Maintenance (Exclusive of Rolling Stock). |

b. Unnumbered Records and Reports.

- (1) Daily rip track progress report (FM 55-22).
- (2) Daily carshop progress report (FM 55-60).
- (3) Report of new cars placed in service (FM 55-60).
- (4) Daily report of loaded cars being held for repairs (FM 55-22).
- (5) Accident and personal injury report (FM 55-22).
- (6) Special reports (as required).

PART FOUR
RAILWAY PLANNING AND INTELLIGENCE
CHAPTER 21
GENERAL

125. General

a. Actual operating conditions affecting military railways may vary widely. The problems presented by one short single track railway will be quite different from those presented by a network of railway tracks. Therefore, instructions and information contained in this manual are stated in general terms and should be so construed.

b. The transportation military railway service initially operates and uses the existing rail lines, equipment, and facilities found in a theater. Only that equipment and construction material necessary to support military operations is brought into a theater to supplement existing facilities.

c. Planning is necessary to determine the adequacy and effective use of rail transportation facilities in any given area. In order to plan effectively and efficiently, essential information should be available concerning the basic characteristics of the line and the nature of the country in which an operation is planned. Combining this information with basic assumptions, estimates can be made of railway capacity as well as requirements for personnel, supplies, and equipment needed to operate the line.

126. Planning in the Zone of Interior

The transportation military railway service has a major part in the logistical aspects of preinvasion planning and later in the execution of these plans in theaters where railways are a major means of transportation. First, the Railway Transport Service Division of the Office of the Chief of Transportation prepares its part of the logistical plan based on detailed intelligence. In the transportation annex, the transportation military railway service requirements for personnel, equipment, and supplies are indicated. The Railway Transport Service Division initiates the necessary staff action to have units organized and trained for procurement of supplies and equipment.

127. Planning in the Zone of Operations

a. The overall staff and planning functions of the transportation military railway service are the responsibility of the commander of the highest echelon of the transportation military railway service unit in a particular theater.

b. The theater transportation officer integrates the railway plan with plans of the other transportation operation agencies and develops the theater transportation plan. The theater transportation officer may delegate this function to the theater army transportation officer who, in turn, may delegate it to the communications zone transportation officer.

128. Railway Reconnaissance

a. The highest echelon of the transportation military railway service in the theater is responsible for the reconnaissance of captured and liberated rail lines as early as practicable. The actual reconnaissance is normally performed by selected personnel from the railway operating battalion, augmented by personnel from rail higher units as required. The reconnaissance should produce the information required for planning (par. 132).

b. The railway operating battalion commander assigned the mission of operating a given section of rail line effects the necessary reconnaissance. He then determines the operating capacity of the line in terms of net tonnage that may be handled, considering the characteristics of the line and the equipment and facilities actually available.

c. Information obtained through reconnaissance, and the resulting plans, are forwarded to the highest echelon of the transportation military railway service in the theater. At each echelon of command, information and plans are combined where necessary and the consolidated plans and information are forwarded to the next higher echelon.

CHAPTER 22

RAILWAY INTELLIGENCE

129. Definitions and Responsibility

a. Railway intelligence is evaluated and interpreted information concerning the railway systems of a country, theater of operations, or geographical area, including all factors required to determine the present or potential capacities of such systems for civil or military purposes.

b. In order to properly prepare rail transportation plans in support of military operations, adequate railway intelligence must be available to transportation planners at various echelons of command. All transportation special staff sections and railway units participate in the collection, processing, and reporting of railway intelligence information.

c. The Chief of Transportation, Department of the Army, is responsible for the production and maintenance of worldwide railway intelligence required for strategic, logistical, and tactical planning. Such intelligence activity is accomplished by the Military Plans and Intelligence Division, Office of the Chief of Transportation, in coordination with the Assistant Chief of Staff, G2, Department of the Army, and theater transportation officers.

d. The theater transportation officer is responsible for collecting, producing, and/or maintaining in readily usable form, rail intelligence concerning the theater of operations as a whole including rail systems and facilities under our own, friendly, or enemy control. Such activity normally is accomplished by the plans and intelligence division, theater transportation section, and assigned Transportation Corps technical intelligence teams in coordination with the Office of the Chief of Transportation, Department of the Army; the theater intelligence officer (G2); intelligence elements of communications zone and army transportation sections; the transportation military railway service; and other staff sections and agencies.

e. The transportation officers at communications zone and army headquarters are responsible for collecting, maintaining, and disseminating current railway information and intelligence concerning their areas of operations and interest. Railway intelligence functions are performed by the plans and intelligence division of communications zone and army transportation sections, assisted

by attached Transportation Corps technical intelligence teams. Collection, processing, and maintenance activities are coordinated with the transportation military railway service, other technical service headquarters, the intelligence officer (G2), and other staff sections and intelligence agencies.

f. The transportation military railway service, through proper channels, furnishes technical advice to the Air Force concerning the selection of rail targets for bombing. Targets should be designated which will deny the enemy full use of the rail lines and yet cause the least amount of reconstruction upon capture.

g. Transportation military railway service commanders assign intelligence functions and coordination responsibilities to the best qualified personnel available. In the field, the forward railway operating battalion commander effects necessary reconnaissance and acts as a collecting agent, working in close coordination with the plans and intelligence division, army transportation section, and attached Transportation Corps technical intelligence teams.

h. Continuous coordination and systematic exchange of railway information and intelligence between intelligence elements of transportation staff sections and the transportation military railway service units are essential. Full use should be made of technical and G2 intelligence channels to insure timely and adequate exchange and maintenance of current railway information and intelligence.

130. Objectives of Railway Intelligence

The transportation military railway service primarily operates and uses the existing rail lines, equipment, and facilities found in a theater. In this connection, an important objective of railway intelligence is to provide the basic data necessary to insure that railway systems within a theater of operations may be placed into effective operation as quickly as possible. Railway intelligence also provides the transportation officer, G2, and other staff planners and intelligence personnel the basis for continuing assessment of our own, friendly, and/or enemy railway transport capabilities, vulnerabilities, and potentialities.

131. Sources of Information

a. Two basic points pertaining to the exploitation of sources of information are the type of information desired and the selection of the best source from which to obtain the information.

b. Essential information on rail lines may be found in maps, equipment registers, maintenance of way and mechanical manuals, timetables, and engineering department railway line charts. One

of the most accurate sources of current information on the physical characteristics of a rail system is aerial photography.

c. Information obtained from the above sources, plus information obtained from aerial and ground reconnaissances, should provide the required intelligence as listed in paragraph 132.

132. Planning and Intelligence Information

a. For staff planning purposes, considerable intelligence is necessary to evaluate the capabilities of rail transport in any country, theater of operations, or geographical area. Full use of rail transportation is impossible without proper and efficient planning. Estimates of railway capacity, personnel necessary to operate the lines, and equipment and supply requirements for a specific railway line must take into consideration the basic characteristics of the line and the nature of the country in which the operation is planned. When such information is not available, assumptions must be made based on available data.

b. Railway intelligence required for planning, operations, and estimation of enemy capabilities includes, but is not limited to, the following:

- (1) General and detailed maps and photographs (ground and air) delineating pertinent aspects of routes, facilities, equipment, and structures.
- (2) General description of the rail system and facilities with reference to ownership, organization, operations, importance in the economic structure, factors influencing development, and military use potentials.
- (3) Detailed basic characteristics and condition of routes, facilities, equipment, structures, operations, and related factors, including—
 - (a) Roadbed, rail, ties, ballast, and drainage.
 - (b) Ruling grade and curve in each direction.
 - (c) Main, siding, yard, station, team, house, spur, electrified, and other tracks.
 - (d) Loading and unloading platforms and facilities.
 - (e) Locomotive fueling, watering, and turning points and facilities.
 - (f) Terminal, yard, shop, and engine housing facilities and equipment.
 - (g) Bridges, tunnels, and train ferries.
 - (h) Traffic interruption factors and bottlenecks.
 - (i) Weather and terrain features.
 - (j) Construction and maintenance problems, practice, labor, and materials.

- (*k*) Locomotives, rolling stock, and special equipment.
- (*l*) Supplies and spare parts.
- (*m*) Signals, dispatching, and other means of communication.
- (*n*) Gage and mileages.
- (*o*) Nature, density, and volume of traffic.
- (*p*) Maximum load limits and minimum clearances.
- (*q*) Operational capacity of lines, facilities, equipment, structures, and personnel.
- (*r*) Safety regulations and provisions.
- (*s*) Main lines and alternate routes, including single, double, and multiple track operations.
- (*t*) Entraining, detraining, and transfer points and facilities.
- (*u*) Number, location, and distance between passing tracks.
- (*v*) Availability of civilian labor, operating personnel, equipment, and other railway material.
- (*w*) Normal distance(s) of movement and turnaround time(s).
- (*x*) Speed restrictions.
- (*y*) Nature and location of demolition chambers.

c. In the absence of information, the staff planner must prepare the essential elements of information required, indicate possible collection agencies, and submit to G2 for necessary action. In combat areas, a valuable collection agency for rail intelligence is Air Force photo-reconnaissance units.

CHAPTER 23

RAILWAY LINE CAPACITY DETERMINATION

133. General

a. Since the impetus of military supply movements is forward, military railway line capacity estimates are generally based on net tonnage moved in one direction. However, total capacity is based on train density and must take into consideration movements of trains in both directions. When the railway net under consideration is composed of several divisions and branch lines, separate estimates should be made for each rail division and branch line.

b. In estimating railway line capacity (payload hauled), the limiting factors are the power of the locomotive and the resistance offered by the grade, the curve, the locomotive, the cars, the lading, and the weather.

c. The formulas and factors presented in the following paragraphs of this chapter are presented in the order in which they must be considered. Appendix II is an illustrative example giving step-by-step procedures for determining rail line capacity. Appendix III consists of tables containing many of the factors which must be considered.

134. Weight on Drivers

The weight on drivers of a locomotive is expressed in short tons. It is that weight which is supported by the coupled driving wheels when they rest on straight and level track. It does not include any of the remaining portion of the locomotive's weight. Different types and classes of locomotives have different weights. All locomotives are constructed to specifications issued by the purchaser, the using railroad, or the manufacturer. The weight on drivers of some locomotives used by the Department of the Army will be found in table I, appendix III.

135. Tractive Effort (TE)

Tractive effort is a measure of the potential power of a locomotive expressed in pounds; it is the horizontal force which a locomotive can exert, providing the wheels do not slip. A locomotive's tractive effort is included in the data supplied by the manufacturer. The tractive effort of some locomotives used by the Department of

the Army will be found in table I, appendix III. Where such data is not available, tractive effort can be computed using the formulas given below. Due consideration must be given to the locomotive's age and condition.

a. Starting and Continuous Tractive Effort. Starting tractive effort is the power that a locomotive has available to move itself and the load it is hauling from a stopped position. Continuous tractive effort is the effort required to keep a train rolling after it has been started. As the train increases in momentum, the tractive effort necessary to keep it moving diminishes rapidly. In steam locomotives, no differentiation is made between starting and continuous tractive effort. A steam locomotive can generally continue to pull what it can start. However, a diesel-electric locomotive cannot continue to exert the same force achieved in starting without damaging its power unit. The continuous tractive effort of a diesel-electric locomotive is approximately 50 percent of its starting tractive effort.

b. Rule-of-Thumb Method of Determining Tractive Effort.

- (1) Starting tractive effort is closely correlated to the adhesion which the driving wheels maintain at the rails. If the tractive effort expended exceeds this adhesion element, the drivers will slip. Normally, the adhesion element when the rails are dry is 30 percent of the weight on drivers; when the rails are wet, 20 percent. Therefore, 25 percent is taken as the average.
- (2) Thus, for a locomotive weighing 80 tons or 160,000 pounds on drivers, the approximate starting tractive effort would be $\frac{160,000}{4}$ or 40,000 pounds.
- (3) If it were a steam locomotive, the continuous tractive effort of the above locomotive would also be 40,000 pounds. If it were a diesel-electric locomotive, the continuous tractive effort would be approximately $\frac{40,000}{2}$ or 20,000 pounds.

c. Tractive Effort Formulas for Steam Locomotives. In a steam locomotive, there are three elements, any one of which may determine its capacity to do work—first, the boiler or steam-making element; second, the cylinder or steam-using element; and third, the weight on drivers and the coefficient of friction. Considering these three elements, the boiler tractive effort and the cylinder tractive effort should never exceed the tractive effort of adhesion.

- (1) *Tractive effort of adhesion.* The formula for tractive effort of adhesion is as follows (see *b*, above).

$$TE_a = fW$$

where

TE_a = tractive effort of adhesion

f = coefficient of friction (average 25 percent)

W = weight on drivers in pounds

- (2) *Cylinder tractive effort.* In computing the ultimate cylinder tractive effort, it is usual to assume 85 percent of the working boiler pressure. This allows for frictional losses through steam passages and valve ports between the boiler and the cylinders. From the established principle that work is force multiplied by the distance through which it acts, the formula for the cylinder tractive effort is—

$$TE_c = \frac{0.85 Pd^2 L}{D}$$

where

TE_c = cylinder tractive effort in pounds

0.85 = a constant

P = working boiler pressure in pounds per square inch

d = diameter of the cylinder in inches

L = length of piston stroke in inches

D = diameter of the driving wheels in inches

- (3) *Boiler tractive effort.* Boiler tractive effort for hand-fired locomotives at critical speed is as follows:

$$TE_b = \frac{80 H}{S}$$

where

TE_b = boiler tractive effort

H = square feet of heating surface (total)

S = speed in miles per hour

d. Tractive Effort Formula for Diesel-electric Locomotives.

- (1) In diesel-electric locomotives, diesel engines drive powerful electric generators. The electric current which they generate operates large electric motors geared to the axles of the driving wheels of the locomotives. Tractive effort of a diesel-electric locomotive depends upon several factors, among which are the characteristics of the electrical components. As the traction motors of a locomotive

are the same, the total power is a multiple of what one motor is capable of doing and is obtained as follows:

$$TE = \frac{T \times 24 \times G \times E \times N}{D \times g}$$

where

TE = tractive effort in pounds

T = torque of motor

24 = a constant

G = number of teeth in gear

E = gear efficiency

N = number of motors

D = diameter of driving wheels in inches

g = number of teeth in pinion.

- (2) In locomotives having the armature mounted directly on the axle, the factors G , g , and E of the tractive effort equation drop out. The torque of the motors produces the tractive effort, and the relation between torque and tractive effort is determined by the current. The torque of a motor is the pull in pounds which the motor can exert at 1-foot radius from the center of the armature shaft. There is a definite relation between the current delivered to the motor and the torque developed, but for practical purposes there is no formula to determine what this torque is. For this reason, in order that the tractive effort of a diesel-electric locomotive may be calculated, the designers furnish with a motor or generator a set of curves obtained by tests. These curves are known as characteristic curves and from them the torque at any speed can be read directly.

136. Drawbar Pull (DBP)

Drawbar pull is the actual pulling ability of a locomotive, less the effort necessary to move the locomotive.

a. Various actual tests have indicated that 16 to 20 pounds of pull per ton are required to start the average locomotive or freight car on straight, level track under favorable weather and temperature conditions. A locomotive or car equipped with roller bearings will start with somewhat less effort. For railway planning, 20 pounds per ton will be used. This resistance drops after equipment starts rolling; but to establish pulling ability (drawbar pull) available for starting and pulling a train, 20 pounds per ton of locomotive weight will be subtracted from the continuous tractive effort of the locomotive.

b. Thus, a diesel-electric locomotive weighing 80 tons on drivers

and having a continuous tractive effort of 20,000 pounds has drawbar pull of 18,400 pounds (20,000 pounds minus 1,600 pounds).

c. Maximum drawbar pull can be exerted only at lowest speeds—up to about 10 miles per hour (mph)—after which it drops off sharply. Drawbar pull at given speeds can be obtained by applying a speed factor to the maximum drawbar pull. However, speed factors are different for different type locomotives. In one type of steam locomotive, drawbar pull was found to diminish in inverse ratio to speed; for example, it is 80 percent at 20 mph, 50 percent at 50 mph, and 20 percent at 80 mph. This may be used as a rule of thumb for estimating drawbar pull of steam locomotives at various speeds. Diesel-electric locomotive drawbar pull diminishes more rapidly at the higher speeds.

137. Rolling Resistance (RR)

The force components acting upon a train in a direction parallel with the track which tend to hold or retard the train's movement constitute rolling resistance. The components of rolling resistance are friction between the railheads and the treads and flanges of the wheels, resistance due to undulation of track under a moving train, internal friction of rolling stock, and resistance in still air. An absolute figure to be used as rolling resistance is unknown. Experience indicates that a safe average value to use in the theater of operations for rolling resistance is as shown in table II, appendix III.

138. Grade Resistance (GR)

Grade resistance is the resistance to the progress of a train offered by a grade. It is caused by the action of gravity which tends to pull the train downhill. As determined by the following formula, grade resistance is equal to 20 pounds per ton of train times the rate percent of grade:

$$R_g = W \frac{r}{b}$$

where

R_g = grade resistance

W = one ton (2,000 pounds)

r = the rate percent of grade

b = one station (100 feet)

thus,

R_g in pounds per ton may be expressed as:

$$R_g = \frac{2,000 \times \text{rate percent of grade}}{100}$$

or,

$$R_g = 20 \times \text{rate percent of grade}$$

139. Curve Resistance (CR)

Curve resistance is the resistance to the progress of a train offered by a curve. No entirely satisfactory theoretical discussion of curve resistance has been published; however, engineers in the United States usually allow from .8 to 1 pound per ton of train per degree of curve. In military railway planning, the factor 0.8 pound per ton of train per degree of curve is used.

140. Weather Factor (W)

a. The weather factor is another expression of train resistance. It reflects, by percentage, the effects of adverse cold and wet weather upon the actual hauling power of a locomotive. Experience and tests have proved that whenever the outside temperature drops below 32°F, the hauling power of a locomotive is decreased. Table III, appendix III, shows the weather factor (percent) for different degrees of temperature.

b. Ordinarily wet weather is regarded as local and temporary and is considered absorbed by average figures. In countries of extended wet seasons (monsoons, fogs, etc.), however, the loss of tractive effort due to slippery rail may prove serious if sanding facilities are lacking. The applicable reduction is a matter of judgment but, in general, tractive effort will not be less than 20 percent of weight on drivers.

141. Gross Trailing Load (GTL)

a. Gross trailing load is the maximum weight or load in short tons that a locomotive may safely pull behind it under given conditions of curvature, grade, or on level track. It is determined by combining the factors discussed in paragraphs 136–140. The formula for gross trailing load is as follows:

$$GTL = \frac{(DBP \times W)}{(RR + GR + CR)}$$

where

GTL = gross trailing load

DBP = drawbar pull

W = weather resistance

RR = rolling resistance

GR = grade resistance

CR = curve resistance

b. When double-heading trains or using pushers, the GTL is equal to the sum of the GTL for each locomotive multiplied by 90 percent for steam locomotives and 100 percent for diesel-electric locomotives.

142. Net Trainload (NTL)

a. Net trainload is the payload carried by the train. The total weight of the cars under load is gross weight; the light weight, or weight of the cars empty, is tare. The difference between these two is the net load or the payload of the train.

b. In military railway planning, the net trainload is taken as 50 percent of the gross trailing load, which is a good average for military railway operations in a theater.

143. Train Density (TD)

a. General.

- (1) The term train density is used to denote the number of trains that may be operated safely over a division in each direction during a 24-hour period. Work trains are not included in computing train density. Train density may vary greatly over various divisions due to the condition and length of the main line; number and locations of passing tracks; yard and terminal facilities; train movement control facilities and procedures; and availability of traincrews, motive power, and rolling stock.
- (2) On single track lines, passing tracks are generally 6 to 8 miles apart. When multiple tracks (three or more) are encountered, they will generally be considered as double track since it is often necessary to remove a portion of all of the third and fourth tracks in order to maintain the double track line.
- (3) The capacity or operating turnover of cars and trains in and out of terminal yards must be considered, either from definite experience and intelligence factors or by inference from other related information (ch. 24).
- (4) The following rule-of-thumb and formulas are primarily designed to determine freight train density; however, they will be reasonably accurate on lines having 20 percent passenger trains included.

b. *Rule-of-Thumb for Determining Train Density.* In the absence of sufficient intelligence upon which to evaluate the potential train density of a rail line, a train density of 10 for single track and 30 for double track will be used as planning factors.

c. *Formula for Determining Single Track Train Density.* When sufficient intelligence is available, the following formula and factors may be used in determining train density for a specified railway division. In determining the number of passing tracks, those less than 5 miles apart should not be included. Passing

tracks selected generally should be uniformly spaced throughout the division.

$$TD = \frac{NT + 1}{2} \times \frac{24 \times S}{LD}$$

where

TD—train density

NT—number of passing tracks

1—constant (number of trains that could be run if there were no passing tracks)

2—constant to convert to one direction

24—constant (number of hours per day)

S—average speed (table IV, appendix III)

LD—length of division

d. Formula for Determining Double Track Train Density. In determining the train density for double track operations, fluidity and flexibility in movement of trains must be maintained. Thus, the number of trains operated should not exceed that number which can be cleared off either main track in case of emergency at any given time. Using the factors in *c*, above, train density for double track may be computed as follows:

$$TD_2 = (NT + 1) \times \frac{24 \times S}{LD}$$

144. Net Division Tonnage (NDT)

a. Net division tonnage is the tonnage (short tons) or payload which can be moved over a railway division each day. It includes railway operating supplies which must be programed for movement the same as the supplies of any other service.

b. Net division tonnage is determined by multiplying the net trainload (NTL) by the train density (TD) of the particular division. Net division tonnage is computed separately for each division.

c. When calculating net division tonnage, certain other factors must be taken into consideration. For example, troop, passenger, or hospital trains will replace an equal number of tonnage freight trains. When the operation of such trains is anticipated, allowance in net division tonnage estimates is made by adjusting the train densities of the divisions concerned.

145. End Delivery Tonnage (EDT)

a. In military operations, the end delivery tonnage is the through tonnage in short tons of payload which may be delivered at the end of the railway line (railhead) each day.

b. In an all-rail movement, the end delivery tonnage is the same as the net division tonnage of the most restrictive division.

CHAPTER 24

RAILWAY YARD CAPACITY DETERMINATION

146. General

a. Railway yards, like other component elements of a railway, are designed to meet the requirements of the economy of the area they serve. Within reasonable limits, they are designed to handle a traffic load varying from average peacetime traffic to peak war-time traffic requirements. Efficiency of operation may decrease when the traffic exceeds the efficient operational capacity of the yards.

b. Railway yard operational capacity has a very definite relation to the number of trains that can be forwarded to or received from the main lines. Thus, although the potential train density of a main line may be 30 trains per day, the actual or operating train density may be less because of limitations of the yards.

c. Railway terminals may include the following:

- (1) Receiving yards.
- (2) Classification yards.
- (3) Forwarding yards.
- (4) Other yards such as holding yards, repair yards, interchange yards, and storage yards.

d. In railway operations, during peak traffic requirements, the classification yard is most likely to become the bottleneck. There are many variables which will affect the number of cars per hour that may be switched.

147. Planning Factors for Classification Yards

For planning purposes the following factors may be used. The factors are based on day and night operation. Where two or more main line railways intersect at a major terminal, the facilities will have to be duplicated accordingly.

a. Flatyard switching—30 cars per locomotive per hour. (Includes time for switch engine to push cars from receiving yard, etc.) (Based on European-type equipment.)

b. Hump yard switching—45 cars per locomotive per hour.

c. The number of cars in a classification yard at any given time should not exceed 60 percent of the yard's capacity.

d. Average number of classifications required for empty cars—5. (Normally trains of empties will be classified in a separate yard.)

e. A typical breakdown of classifications tracks required for loaded cars could be as follows: Ordnance V, 2; Quartermaster I, II and IV, 2; Quartermaster III, 2; Engineer, 2; Chemical, 1; Signal, Medical and Transportation Corps, 1; Air Force, 2; empties, 2. In heavy traffic areas one track may be provided for each classification plus 25 percent additional tracks for rotation.

f. Length of track—1 train length, plus 20 percent, plus 300 feet. The length of tracks and/or trains will vary with local terrain characteristics, railway equipment, and requirements.

g. The number of switch engines per shift that may be employed in the operation of the loaded freight classification yard may vary from 1 to 3, depending on the yard layout. Thus, 1 switch engine may handle 30 to 60 cars per hour and 3 switch engines may handle 90 to 180 cars per hour. The breakdown of functions would be as follows:

- (1) One switch engine at the receiving yard preparing cut of cars for switching—20 to 30 minutes.
- (2) One switch engine with cut of cars switching cars into the classification yard—20 to 30 minutes.
- (3) One switch engine on opposite end of classification yard coupling cars and performing secondary switching.
- (4) Thus, in slack traffic periods, one switch engine may be used for the above functions. During peak periods, three switch engines and possibly four may be used. It must be understood that the switch engine requirements being discussed are for use in the classification yard operation only and do not include those engaged in supporting other terminal operations.

h. Average time car remains in classification yard—8 hours.

i. Average times per day classification yard traffic turns over—3 times. (Some cars may be held 48 hours, while others may clear in less than 4 hours.)

j. Cars should be classified by commodity—that is, gas trains, refrigerator trains, ammunition trains, or ration trains—for one destination where possible. Where solid classified trains are not operationally feasible, the number of blocks per train should average three classes or commodities and/or destinations.

148. Planning Formulas for Classification Yards

The following formulas may be used to determine classification yard requirements and capabilities.

a. Required Length of Yard Tracks.

$$LT = ACT \times LC \times 1.2 + 300 \text{ ft}$$

where

LT = length of track

ACT = average cars per train

LC = length of car (average).

1.2 = operational factor

300 ft = clearance distance at each end of track from point of switch to clearance

b. Minimum Number of Tracks Required.

(1) Loaded car classification yards (par. 150).

$$NTR = \frac{TD}{3} \times 1.7$$

where

NTR = number of tracks required

TD = train density

3 = yard turnover per day

1.7 = factor for 60 percent operating capacity

(2) Empty car classification yards (par. 150).

$$NTR = \frac{TD}{3} \times 1.4$$

c. Daily Yard Capacity.

$$YC = NT \times 70 \times V$$

where

YC = yard capacity, daily

NT = number of tracks available

70 = constant

V = variable in percent increase or decrease which the capacity of the average track varies from 50 cars; that is, if the average track is 60 car lengths long, $V = 1.2$; if 40 car lengths long, $V = .8$

d. Estimate. A broad estimate of dairy yard capacity may be computed by multiplying the static car capacity of the yard by 1.5.

149. Planning Factors for Terminals with and without Receiving and Forwarding Yards

a. Without Receiving and Forwarding Yards. Normally the receiving and forwarding trainyards will be in balance with classification and main line capacity. However, some railways dispense with receiving and forwarding yards and operate all trains directly into and out of classification yards. In such cases, the classification yard daily capacity will be reduced by approximately 25 percent.

b. With Receiving and Forwarding Yards. Where trains are operated into and out of terminals at 48-minute intervals, there should be a minimum of 6 tracks plus 1 runaround track in the receiving and in the forwarding train yards to handle both empty and loaded trains. In general, the number of tracks required equals the train density divided by 5, plus 1 $\frac{(TD + 1)}{5}$.

150. Planning Factors for Terminals with Bidirectional Tonnage Traffic

In large terminals where tonnage traffic is bidirectional, the various yards are normally designed with yards for each direction; that is, northbound receiving, classification, and forwarding yards; and southbound receiving, classification, and forwarding yards.

CHAPTER 25

RAILWAY EQUIPMENT REQUIREMENTS

151. General

a. Availability of equipment in liberated or occupied territory will depend upon inventories and extent of destruction, condition of equipment, types of fuel and local availability, availability of spare parts, types of coupling devices, and many other such factors. Allowances for use of captured or locally available equipment should be based on judgment after evaluation of the many factors involved.

b. Technical data concerning railway equipment may be found in strategic surveys, special transportation studies based on intelligence reports, reports of governments or railways in peacetime, and sometimes in publications such as the Railway Gazette (British) and the Railway Age (American).

c. The equipment requirements to be considered in planning fall into three categories.

- (1) Rolling stock, consisting of boxcars, gondolas, flatcars, tank cars, and refrigerator cars.
- (2) Road engines, the motive power used to pull trains between terminals or division points.
- (3) Switch engines, the motive power used to switch cars within yards or at division terminals.

d. Appendix II is an illustrative example giving step-by-step procedures for determining railway equipment requirements.

152. Rolling Stock

a. General.

- (1) If the continuity of car loadings and movements is to be maintained, sufficient cars must be available. In most military railway operations, tonnage movement is unidirectional from port or base depot areas to forward advanced section or army depots and railheads. Occasionally, tonnages will move from ports to base depots and are unloaded within the limits of the first railway division. Other tonnages will be picked up at the base depot and moved on forward by the same train. This is commonly known as a setout and fillout operation, and the net division tonnage for the division remains approximately the same.

- (2) Table V, appendix III lists representative types of United States Army rolling stock used by the Transportation Corps in a theater of operations. This table lists the rated capacities of the various types of cars. In a theater it is rarely possible to load cars to capacity; therefore, in planning, the carrying capacity (payload) of a car is considered to be 50 percent of its rated capacity.
- (3) Intelligence data should provide the characteristics of local railway equipment available in the area under consideration.

b. Broad Planning. Table VI, appendix III, shows the distribution and disposition of rolling stock for the operation of a military railway. The term "1 day's dispatch" is the number of cars dispatched in a day from the base of operations. For broad planning purposes, the number of cars dispatched from a division terminal, railhead, etc., may be considered the same as the number dispatched from the base of operations. Therefore, 1 day's dispatch is considered the same for all divisions of the railway in operation. In broad planning it is also assumed that all divisions between the base of operations and the railhead will be operated at the same train density and will handle the same number of cars per train. The number of cars required is computed as follows:

- (1) Determine the value of 1 day's dispatch by multiplying the number of cars required per train by the train density of the first division. The number of cars required per train is obtained by dividing the net trainload (par. 142) by the net payload of the cars to be used.
- (2) When the number of divisions and the number of cars in 1 day's dispatch are known, table VI, appendix III may be used to determine the number of cars required for the operation. To this total, add 10 percent to allow for routine maintenance, bad order cars, operational peaks, etc.

c. Detailed Planning.

- (1) The formula below may be used for computing car requirements for each division by substituting proper values for each factor—

$$\text{No. of cars required} = TD \times 2 \times CPT \times 1.15 \times \frac{(RT + TF)}{24}$$

where

TD = train density

2 = constant for two-way traffic

CPT = number of cars per train

1.15 = factor for maintenance and car pool

RT —running time (length of division divided by average speed)

TF —time factor (switching, loading and/or unloading time)

24—number of hours per day

- (2) Values of TF may be determined by analysis of the rail line operation under consideration using the following factors. Where loading and unloading is accomplished on the same division, increase TF by a percentage of the first and second factors given below equal to the proportion of the net division tonnage set out or filled out.

24—Division terminals having major loading points, classification yards, and/or interchange facilities.

12—Division terminals having major unloading points or classification yards.

4—Intermediate terminals having no significant loading, unloading, or classification operations. (Primarily traincrew and locomotive change points or points where the gross trailing load is increased or decreased due to gradient or adjacent divisions. Local loading or unloading of cars does not exceed 10 cars per day.)

153. Road Engines

The number of road engines required for operation over a given railway division may be determined by the following formula:

$$\text{Road engines required} = \frac{TD \times (RT + TT)}{24} \times 2 \times 1.20$$

where

TD —train density

RT —running time (length of division divided by average speed)

TT —terminal time (time for servicing and turning locomotive (table VII, app. III))

24—number of hours per day

2—constant for two-way traffic

1.20—constant allowing 20 percent reserve

Note. The expression $\frac{RT+TT}{24}$ is the percent of time during a 24-hour period in which a road engine is in use and is called the engine factor. The expression provides for the pooled use of motive power which may make one or more trips per day over a short division.

154. Switch Engines

a. No. two port, division, or terminal railheads are alike in design or operation; however, the functions of the main yards in each are essentially the same. Receiving cars from whatever sources and classifying and reassembling them for delivery or forward movement constitute the main functions of any yard. The type of motive power used for this portion of the railroad is the switch engine.

b. The number of switch engines required at a terminal is based on the number of cars dispatched and received, or passing through, the terminal per day (par. 152). When the number of cars has been computed, that figure is applied to table VIII, appendix III, to determine the number of switch engines required at each terminal.

c. When the total number of switch engines required for the railway line has been computed, add 20 percent as a reserve to allow for maintenance, operational peaks, etc.

CHAPTER 26

RAILWAY PERSONNEL REQUIREMENTS

155. General

Transportation military railway service personnel requirements in a theater depend principally upon the number of railway operating battalions required. All other transportation military railway service units are used to support or supervise the operating battalions. In turn, the number of operating battalions required depends primarily upon the number of traincrews (both road crews and switch crews) required. Appendix II is an illustrative example giving step-by-step procedures for determining railway personnel requirements.

156. Road Crews

a. In computing the number of road crews required for each division, the time a road crew is on duty must be considered. This time includes—

- (1) A 2-hour call period at the originating terminal for the crew to report for duty, receive orders and instructions, move the locomotive from the roundhouse to the outbound yard, couple to the train, test the air, and check the train consist.
- (2) The running time involved, which is computed by dividing the length of the division by the average speed of the train. If data is not available to compute the speed, average speed in a theater may be assumed to be 8 miles per hour.
- (3) A 1-hour period at the final terminal to place a train on the designated track, move the locomotive to the roundhouse, and submit necessary reports.

b. Normally, the sum of the call period, the running time, and the period at the final terminal should not exceed 12 hours in order to allow sufficient time for the crews to rest. This combined time can be exceeded for short periods in emergencies, although experience shows that safety and efficiency factors decrease when crews have to work continuous daily shifts of longer than 12 hours. It is possible, however, to work shifts of 16 to 18 hours, provided the crews have a sufficient period of rest before reporting for another

run. Sometimes, it will be necessary to designate longer hours because of the length of the division involved. In such cases, enough time off between runs should be permitted to limit the average daily shift to 12 hours.

c. The following formula may be used in determining the number of road crews needed per division:

$$\text{Number of road crews} = TD \times 2 \times \frac{RT + 3 \times 1.25}{12}$$

where

TD = train density

2 = factor to convert to two-way traffic

RT = running time (length of division divided by average speed)

3 = time allowed for 2-hour call period plus 1-hour period at the final terminal

12 = 12-hour shift per road crew per day

1.25 = constant factor to allow for sickness and other absences

157. Switch Crews

a. To determine the number of switch crews required, the number of switch engines in use at each terminal must be known (par. 154). Two crews are required per switch engine per day.

b. The following formula may be used to determine the number of switch crews required for each terminal. (Do not compute crews for reserve switch engines.)

$$\text{Number of switch crews} = SE \times 2 \times 1.25$$

where

SE = number of switch engines

2 = two crews per engine

1.25 = constant factor to allow for sickness and other absences

158. Railway Unit Requirements

(fig. 11)

a. *Railway Operating Battalions.* The number of operating battalions required is normally determined by dividing the total crews required (road and switch crews) for the entire line by 50 (50 crews per battalion). However, the number of operating divisions into which the rail line is divided must be considered. For instance, if a 3-division line requires 170 crews to operate it, the normal assignment would be 3 operating battalions augmented by 20 crews from TOE 55-500R. Likewise, if a line were divided into 4 operating divisions and required 190 crews, 4 operating battalions would be assigned to operate it. The length of the divisions and the type of operation must also be considered, where necessary.

b. *Railway Shop Battalions.* Railway shop battalions are assigned on the basis of 1 per 2 to 4 railway operating battalions. One or two shop battalions may be assigned to each railway group.

c. *Railway Groups.* Railway groups are assigned on the basis of 1 per 2 to 6 railway operating battalions. The railway group can also supervise 1 or 2 railway shop battalions.

d. *Railway Commands.* Railway commands are assigned on the basis of 1 per 2 or more railway groups.

e. *General Headquarters, Transportation Military Railway Service.* This unit is assigned on the basis of 1 per 2 or more railway commands.

f. *Railway Workshops (Mobile).* These units are assigned on the basis of 1 or more per railway group.

g. *Transportation Depot Company.* This unit is assigned on the basis of 1 per railway command when required.

NORMAL ASSIGNMENT

CAPABILITIES

1 PER MAJOR THEATER
OF OPERATIONS

SUPERVISE 2 OR MORE
TRANS RY COMMANDS

1 PER THEATER OF
OPERATIONS
(2 OR MORE PER GHQ)

SUPERVISE 2 OR MORE
TRANS RY GROUPS

1 PER TRANS RY COMD

RECEIVE, STORE, AND
ISSUE RAIL SUPPLIES

1 OR MORE PER
TRANS RY COMD

FORWARD AREA FIELD
MAINTENANCE OF
EQUIPMENT

2 OR MORE PER
TRANS RY COMD

SUPERVISE 2 TO 6
RY OPR BN AND
1 OR 2 RY SHOP BN

2 TO 6 PER
TRANS RY GROUP

OPERATE AND MAINTAIN
1 RAILWAY DIVISION
(90 TO 150 MILES)

1 OR 2 PER
TRANS RY GROUP
(1 PER 2 TO 4
RY OPR BN)

PERFORM DEPOT
MAINTENANCE IN
SUPPORT OF 2 TO 4
RY OPR BN

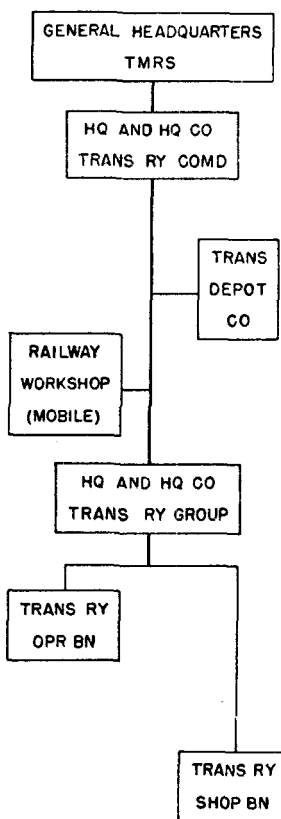


Figure 11. Assignment and capabilities of transportation military railway service units.

CHAPTER 27

RAILWAY SUPPLY REQUIREMENTS

159. General

Generally, railway supply tonnages are quite large. Experience has shown that approximately 5 to 10 percent of the tonnage hauled over the second and third divisions of a railway and 15 percent of the tonnage hauled over each succeeding division are railway operating supplies. These supplies consist of the many and varied items of supply necessary in rail operations. This chapter gives the method of arriving at specific supply requirements; namely, fuel, lubricants, and spare parts. Appendix II is an illustrative example giving step-by-step procedures for determining these railway supply requirements.

160. Fuel

a. Steam Locomotives, Coal-burning. Steam locomotives use coal or oil to produce their heat which, in turn, produces the steam for power. Table IX, appendix III, lists the average fuel requirements for representative types of standard Transportation Corps locomotives. The requirements for coal-burning road locomotives are given in pounds per train mile; for switch engines, in pounds per hour. With this table the coal requirements for both road engines and switch engines can be computed. The following are involved:

(1) *Road engines.*

- (a) Multiply the train density of the first division by 2 (two-way travel). Multiply this result by the length of the first division. This gives the train-miles per day.
- (b) Continue the same procedure for the second and subsequent divisions, and total the train-miles for all divisions.
- (c) Multiply the total train-miles by the coal consumption factor for the locomotive concerned. The result will equal the pounds of coal used per day. (The coal consumption factor is found in table IX, appendix III. For coal-burning road engines it is stated in pounds per train-mile.)
- (d) Divide the total pounds of coal used per day by 2,000 to determine the number of short tons used per day.
- (e) Multiply the result by 30 (the average-day month) for the number of short tons required per month.

- (f) Add 10 percent to this computed coal consumption to allow for contingencies.

(2) *Switch engines.*

- (a) Take the number of switch engines required (par. 154) *without the 30 percent reserve factor added.*
- (b) Multiply this actual number of switch engines by 20 (normal hours per day in operation).
- (c) Multiply the result by the appropriate coal consumption factor for switch engines (given in pounds per hour) for a total coal consumption rate of pounds per day of operation.
- (d) Same as fourth step, (1) (d) above.
- (e) Same as fifth step, (1) (e) above.
- (f) Same as sixth step, (1) (f) above.

b. *Steam Locomotives, Oil-Burning.* Table IX, appendix III, also lists the estimated rate of fuel requirements for oil-burning steam locomotives. The method used to determine the quantity (in short tons) of fuel oil required for the operation of road locomotives and switch engines follows the same procedure, step-by-step, as outlined in *a*, above, for coal-burning engines. The only exception is in the sixth step. For oil-burning steam locomotives, allow only 5 percent for contingencies. The reason for this is that fuel losses when burning oil are not so great as when burning coal. Normally, when all factors have been considered, it will be found that 1 pound of oil possesses as much heating value as $1\frac{3}{4}$ to 2 pounds of average coal.

c. *Diesel-Electric Locomotives.*

- (1) Table IX, appendix III, shows an estimated average rate of diesel fuel oil consumption in gallons per train-mile for diesel-electric road locomotives and in gallons per hour of operation for switch engines. Again for planning purposes, assume the operation of switch engines to be 20 hours per day.
- (2) The method used to determine the quantity, in gallons, of diesel fuel oil required by road locomotives and switch engines follows the same procedure, step-by-step, as applied to coal-burning engines in *a*, above. Again, the only exception is the sixth step where 5 percent is added to the computed consumption to allow for contingencies.

161. Lubricants

a. Lubricants must be used on all moving parts of railway tools, appliances, and machinery and on all motive power and rolling stock. However, for planning purposes only the lubricants neces-

sary for the operation of motive power and rolling stock will be considered.

b. Lubricating oil and grease requirements for motive power and rolling stock are based on an estimate of 1,000 pounds per month for each train per day moving in either direction over each division. Beginning with the first division, select the train density established for the division, multiply this by 2 (for two-way travel), and multiply the result by 1,000. This equals the amount in pounds of lubricants required per month for the division. Continue this procedure for each successive division, and total the pounds of lubricants for a grand total in pounds required per month for the railroad.

162. Spare Parts

a. In a theater, supplies and spare parts will seldom be found in the number and of the kind necessary to maintain the motive power and the rolling stock used by the transportation military railway service. For planning purposes only the spare parts necessary for the maintenance of motive power and rolling stock are considered.

b. An estimate of spare parts required is based upon a factor of 1.5 short tons per month for each train per day moving in either direction over each division. Beginning with the first division, select the train density established for the division, and multiply by 2 (for two-way travel). Multiply this result by 1.5 to get the total amount in short tons of spare parts required per month for the division. Continue this procedure for each successive division, and total the amounts for a grand total of short tons required per month for the entire railroad.

CHAPTER 28

RAILWAY CONSTRUCTION AND REHABILITATION

Section I. GENERAL

163. General

a. This chapter is concerned mainly with the construction and rehabilitation of such railway facilities as roadbed, track, terminals, fuel and water facilities, culverts, and bridges. Installation and maintenance of railway signals and communications are discussed in paragraph 103.

b. Although railway construction and rehabilitation are functions of the Corps of Engineers, it is important that transportation officers know the basic planning principles applicable to railway construction and rehabilitation. Such knowledge enables the Transportation Corps planner to arrive at the most feasible recommendations for railway construction and rehabilitation.

164. Responsibilities of the Corps of Engineers (AR 55-650)

a. The Corps of Engineers is responsible for the construction, rehabilitation, and major maintenance of military railways, including stockpiling of construction material and construction equipment required therefore. (See AR 55-650 for definitions of railway construction, railway rehabilitation, and major maintenance of railways.)

b. In the theater of operations, the Corps of Engineers will prepare working plans and estimates, and make preliminary preparations for the construction of railways.

165. Responsibilities of the Transportation Corps

a. The transportation military railway service is responsible for planning and recommending to the communications zone transportation officer rail lines to be constructed and/or rehabilitated.

b. The transportation military railway service will coordinate with the army area, communications zone, or communications zone section engineer who is responsible for the supervision of the construction or rehabilitation. The transportation military railway service will furnish technical advice and assistance, within its capabilities, as requested by the engineer.

Section II. NEW CONSTRUCTION

166. General

a. Railway facilities required will depend upon the scope of the operation and will vary greatly in different theaters of operations. In the construction of new rail lines, prompt completion is of primary importance; therefore earthwork should be reduced to a minimum, even at the expense of mileage and, to some degree, of curvature and grade. The roadbed and track will be as light as is consistent with objectives to be attained. No attempt is made to build for permanence as is required in commercial railway construction.

b. Although the Corps of Engineers prepares the detailed railway construction plan, the transportation planner must consider the factors discussed in the following paragraphs before he can submit a sound recommendation as to where a new rail line should be constructed and of what the facilities should consist.

167. Main Line

a. Full use will be made of the existing rail net, and new railway track construction should be held to an absolute minimum. Such construction will be requested only when the existing facilities are found to be inadequate.

b. A military railway will have its general direction fixed, based upon the starting point and the terminus of the proposed line. The route of a new military railway should be located to save man-hours of construction, rather than cost of materials. The route selected should involve a minimum of grade, curvature, cuts, fills, bridges, and tunnels. The use of topographic maps will assist in route selection.

c. The maximum allowable grade will generally be the deciding factor in selecting the alinement. Natural drainage lines such as rivers, inland waterways, shorelines, etc., present the easiest and most regular gradients, and with few exceptions will not exceed those permissible for railway construction.

d. All things being equal, the shortest route between the initial point and the objective should be the one to follow. However, excessive grades and construction difficulties may outweigh the advantage of the shorter route.

e. Essential requirements of a main line track are—

- (1) Suitable roadbed—stable, well-drained, and properly ballasted.
- (2) Grades, curvature, and rail weights suitable for the weight and operating characteristics of the motive power and rolling stock to be used.

168. Bridges and Tunnels

a. The construction of tunnels and long bridges should be avoided wherever possible. In addition to requiring large expenditures of time, material, and labor, such structures are exceedingly vulnerable to enemy action and sabotage.

b. When bridges and tunnels are constructed, the bridges should be of sufficient strength to support the motive power, rolling stock, and military loads. Both bridges and tunnels should have sufficient clearance to pass the motive power, rolling stock, and military loads.

169. Passing Tracks

Passing tracks are generally located at 6- to 8-mile intervals. They must be sufficiently long to provide complete clearance for the length of trains to be operated over the division. Failure to provide adequate passing tracks will limit the end delivery tonnage of the railway line. The number of passing tracks required is based on the anticipated volume of traffic and train density.

170. Terminals, Yards, and Railheads

a. Properly planned and located terminals, yards, and railheads are essential.

b. To insure proper and efficient handling of personnel and supplies, railway terminals should include various types of buildings such as barracks, warehouses, messing facilities, etc. Terminals should also include adequate ramps, roads, loading platforms, and other loading and unloading facilities. For servicing motive power and rolling stock, provision should include facilities for heavy or light repairs, depending upon the operation, and fuel, water, and sand facilities.

c. Yards should be of sufficient size and length to handle the proposed workload adequately.

d. A railhead is a yard or terminal on, or at the forward end of, a military railway at which troops and supplies are discharged and forwarded by other transportation agencies. A forward railhead should be located beyond the range of enemy artillery fire and should be protected from mechanized and air attacks.

171. Fuel and Water Stations

a. At railway terminals, fuel and water facilities should be located on one track near the roundhouse to permit servicing locomotives with a minimum of delay.

b. Water facilities should also be at convenient locations near outlying points of the classification yard where switching service

is provided if steam locomotives are used in switching. If steam locomotives are used in road service, the distance between water stations along the main line should not exceed 30 miles.

c. Fuel stations are generally located only at terminals, rail-heads, and outlying yards. However, the distance between fueling stations on the main line will not exceed the full carrying capacity of the locomotives plus a wide margin of safety. If steam locomotives are used in road service, intermediate fuel stations on the main line will be located as follows:

- (1) None—if division is less than 85 miles long.
- (2) One—if division is from 85 to 150 miles long.
- (3) Two—if division is over 150 miles long.

172. Construction Effort

a. Construction effort in terms of material and man-hours required for the construction of new rail lines is given in tables in FM 101-10. The use of these tables in preparing detailed bills of materials and estimates of man-hours is a function of the Corps of Engineers.

b. Comparison of new construction tables with rehabilitation tables in FM 101-10 will vividly show the great savings in material and manpower in rehabilitating rail lines whenever possible rather than constructing new lines. For example, the requirement for the new construction of a 100-mile division is 1,700,000 man-hours of labor and 58,300 tons of material as compared to 635,200 man-hours of labor and 26,827 tons of material required for the rehabilitation of a 100-mile division originating at a port of entry.

Section III. REHABILITATION

173. General

a. Rehabilitation refers to the repair of existing track and facilities to return them to serviceable condition. Essential tracks and facilities which must be rehabilitated (par. 65) in order to make a line operable are substantially the same as those listed under new construction in paragraphs 167-171.

b. The Corps of Engineers is responsible for preparing the detailed railway rehabilitation plan, but the transportation planner must indicate which lines and facilities should be rehabilitated. An understanding of destruction areas and rehabilitation requirements will assist the transportation planner in selecting rail lines and facilities for rehabilitation.

174. Areas of Destruction

a. Normally railway destruction is heaviest near ports of entry and lighter inland. Rehabilitation requirements are based on a percentage of demolition which is established by areas. Obviously, advance planning is extremely difficult; therefore, every effort should be made to obtain aerial photographs of the areas before moving in for railway operation.

b. Areas of destruction are broadly defined in terms of miles based on experience gained in World War II. Tables showing rehabilitation requirements for each of the three following areas may be found in FM 101-10:

- (1) Inland 0 to 30 miles from the coast.
- (2) Inland 30 to 100 miles.
- (3) Farther than 100 miles inland.

c. Experience also shows that great destruction to rail facilities occurs in yards and terminals.

175. Rehabilitation Effort

a. As stated in the preceding paragraph, rehabilitation effort in terms of material and man-hours for the rehabilitation of rail lines is given in tables in FM 101-10. The use of these tables in preparing detailed bills of materials and estimates of man-hours is a function of the Corps of Engineers.

b. It was pointed out previously that the effort required for rehabilitation is much less than that required for new construction. The savings in man-hours is chiefly due to the fact that for rehabilitation right-of-way does not have to be cleared and ballast does not have to be procured and spread. The fact that much of the material (ties, rail, lumber) is reusable accounts for the difference in material required.

CHAPTER 29

RAILWAY ENGINEERING DATA

176. General

Existing railroad tracks and facilities in a theater of operations must be used to their fullest extent. New construction of port trackage, terminals, and other special needs of the military railway service are usually all that can be undertaken in a theater of operations. Reconstruction or rehabilitation of large portions of existing railroad facilities must be anticipated following or concurrent with major advances. Good engineering judgment is necessary before and during railroad rehabilitation; therefore, some of the basic engineering data required in estimating capabilities of existing facilities will be discussed in this chapter. These include curvature, grade lines, and bridge capacities.

177. Curvature

(figs. 12, 13, and 14)

a. General. The alinement of a railroad consists of straight sections, called tangents, connected by curved sections. American engineers use degrees, minutes, and seconds when measuring or expressing the sharpness of a curve. Curves are classified as simple (fig. 12), compound (fig. 13), and reverse (fig. 14).

- (1) A simple curve (fig. 12) is a single arc connecting two tangents, for example—

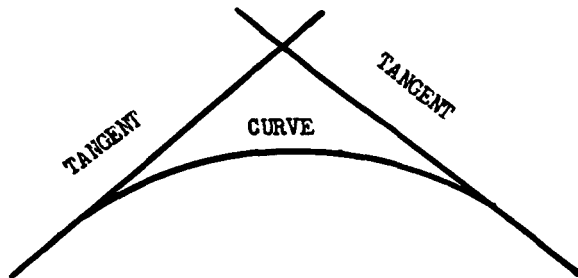


Figure 12. Simple curve.

- (2) A compound curve (fig. 13) is formed by two simple curves of different radii, both of which curve in the same direction, thus—

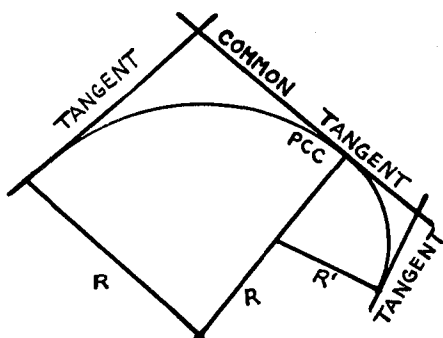


Figure 13. Compound curve.

- (3) A reverse curve (fig. 14) consists of two simple curves which bend in opposite directions, for example—

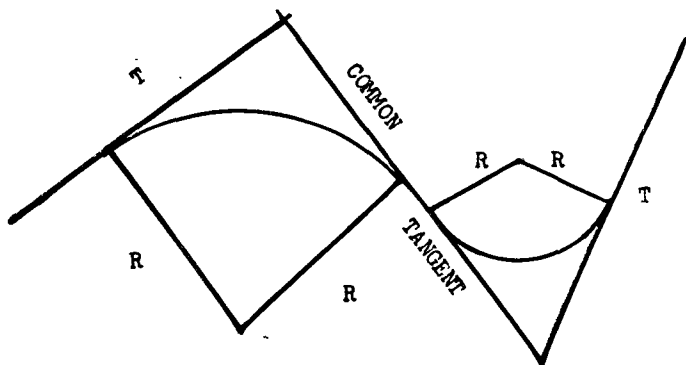


Figure 14. Reverse curve.

b. Degree Determination (Formula). American engineers use 100 feet as the invariable length of a unit chord for curve computations; however, it is possible to obtain an approximate value of R from the following simple empirical formula, in which D is expressed in degrees and R is the radius expressed in feet:

$$R = \frac{5,730}{D} \quad \text{or} \quad D = \frac{5,730}{R}$$

(The approximate length of the radius of a 1° curve is 5,730 feet. This formula may be used when D is small, as results from this method are generally correct to $\frac{1}{10}$ of 1 percent. For cases where D is large, the relationship $R = \frac{50}{D/2}$ or $D = 2 \arcsin \frac{50}{R}$ should be used.)

c. *Degree Determination (Approximate)*. The string method may be used in the field to determine the approximate degree of curvature when a surveying instrument is not available. When determining the curvature by the string method (fig. 15), select a portion well within the main body of the curve. Measure a chord distance of 62 feet along the inside of the high rail (points A and B, fig. 15). Stretch a string or strong cord very tightly between points A and B and measure the distance M at the midpoint of the chord. This distance in inches is approximately equal to the degree of curvature; for example, 5 inches=5°. As a curve gets sharper, this distance increases. A 10° curve is sharper than a 5° curve.

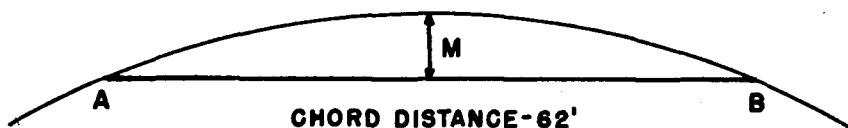


Figure 15. Degree determination using the chord system.

d. *Maximum Curvature*. A straight line is the shortest distance between two points; however, should a straight line result in too steep a grade or in numerous bridge and tunnel constructions, it is not the best location for a railroad line. Judicious and skillful use of curves offers the most satisfactory and, in many cases, the only means of locating track with grades, bridges, and tunnels held to a minimum. However, when laying out new railroad locations, the planner should eliminate as many curves as possible, keeping those necessary for economical construction to an absolute minimum degree of curvature. Table I, appendix III, indicates the maximum curvature that locomotives used by the Department of the Army can traverse; however, it is better to keep curvature at a minimum rather than require locomotives to traverse maximum degrees of curvature.

178. Gradelines

a. The planner should keep gradelines to a minimum because the maximum allowable grade is generally the deciding factor in selecting alinement; it limits the load a train may move over a division or line. Gradelines, or gradients, are designated by the vertical change in 100 feet. A grade rising 2 feet in a horizontal distance of 100 feet is called a +2.0 percent grade; one descending the same amount is called a -2.0 percent grade. Any grade from 0.0 percent, or level, to 0.4 percent is called light; greater than 0.4 to 1.0 percent, moderate; greater than 1.0 to 2.0 percent, heavy; and above 2.0 percent, very heavy. An ascending grade of 1.0 percent

reduces by about $\frac{1}{5}$ the tonnage a locomotive can pull on straight and level track.

b. Usually, on each division or at one location on the line, a grade occurs which sets the maximum tonnage a given locomotive can pull; this is called the ruling grade. A short, steep grade may not be the ruling grade, since tonnage trains may be longer than the grade, or may be carried over the grade by the momentum of the train without any great reduction in speed. A long grade which requires the locomotive to pull the train over the entire grade and which has a gradient that limits the tonnage a given locomotive can pull is classed as a ruling grade.

179. Bridge Capacity

a. *Bridge Loading.* Bridges are designed to carry safely a specific concentrated load. Loads which may be placed on a structure temporarily or which may be changed in position are termed live loads to distinguish them from fixed dead loads, or static loads. Live loads are the tonnage trains; dead loads are the superstructure, tracks, ties, etc. The maximum load, usually specified, consists of two locomotives coupled followed by a uniform trainload. Various bridge loadings have been used, producing a great divergence in specifications and variable results. Of the innumerable loading formulas proposed, the only one which has had any extensive use is that proposed by Theodore Cooper in 1884. In this formula, each driving axle of the locomotive carries a proportionate part of the total weight loaded on the drivers. This method or formula is called Cooper's E rating. The rating for a bridge to carry a 2-8-0 locomotive weighing 140,000 pounds on the drivers is determined as follows: A 2-8-0 locomotive has 4 driving axles; $140,000 \div 4 = 35,000$ pounds, the amount each driving axle will carry. A bridge designed to carry this locomotive safely must have a Cooper's rating of at least E-35 (tables X and XI, app. III).

b. *Steel and Wooden Stringer Bridges.* There is usually an economical consistency throughout the design of all parts of a railroad bridge. Dimensions of the floor system offer a clue to the loading used in the design of the whole structure. Tables X and XI show the Cooper's E rating of a number of typical railroad bridges and the dimensions of the stringers of their floor systems.

- (1) *Steel.* To estimate the capacity of a railroad bridge with steel stringers, or girders, as part of the floor system, measure the width and thickness of the lower flange of the stringer at the center of the span length. Also measure the depth and length of the stringer (fig. 16). Using table X, read the corresponding E rating of the bridge.

The rating should be reduced according to the age and condition of the bridge.

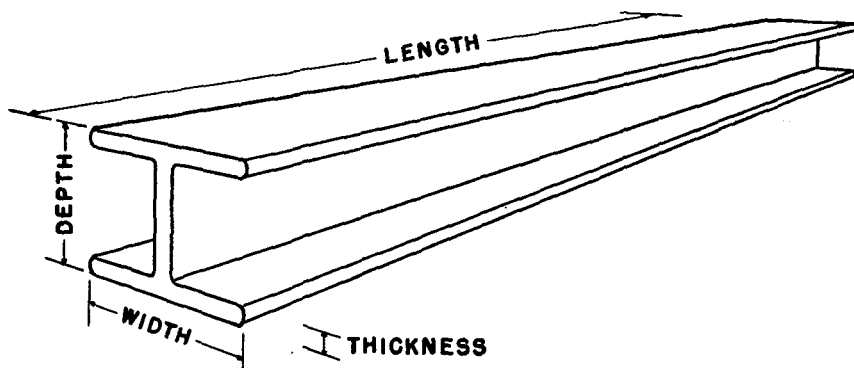


Figure 16. Measuring a steel stringer.

- (2) *Wood.* To estimate the capacity of a railroad bridge with wooden stringers as part of the floor system, measure the width of each of the stringers under one track at the center of the span length and add for total width. Also measure the depth and length of one stringer (fig. 17). Using table XI, select the wooden stringer most nearly approximating these dimensions and read off the corresponding E rating of the bridge. The rating should be reduced according to the age and condition of the bridge.

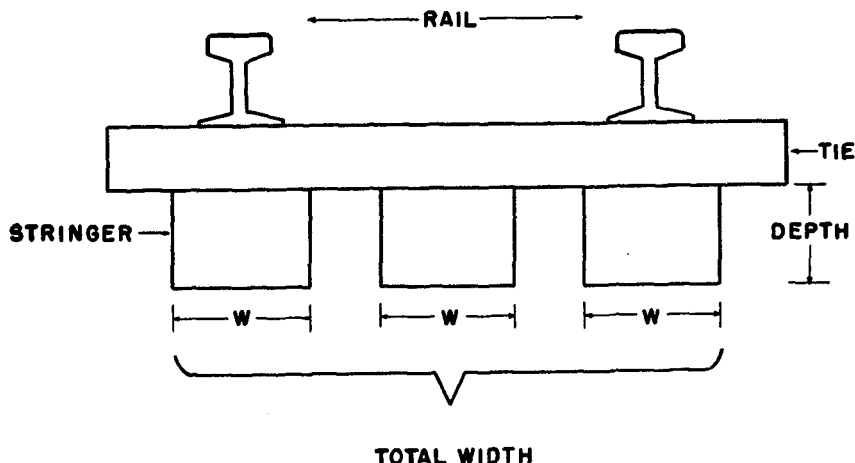


Figure 17. Measuring wooden stringers.

APPENDIX I

REFERENCES

1. Field Manuals

FM 5-25	Explosives and Demolitions.
FM 21-5	Military Training.
FM 55-10	Movement Control in Theaters of Operation.
FM 55-22	Transportation Railway Operating Battalion.
FM 55-60	Railway Shop Battalion.
FM 55-56	Operation of Railroads; Operating Rules.
FM 100-10	Field Service Regulations Administration.
FM 101-5	Staff Officer's Field Manual Staff Organization and Procedure.
FM 101-10	Staff Officer's Field Manual Organization, Technical and Logistical Data.

2. Technical Manuals

TM 5-370	Railroad Construction.
TM 5-627	Railway Track Maintenance; Repairs and Utilities.
TM 55-270	Operation of Railroads; General Instructions for the Inspection and Maintenance of Locomotives and Locomotive Cranes.
TM 55-271	Operation of Railroads Diesel-Electric Locomotives.
TM 55-274	Operation of Railroads Locomotive Repair Shops.
TM 55-205	Railway Communications and Signals.
TM 55-285	Operation of Railroads General Instructions for the Inspection and Maintenance of Rolling Stock.
TM 55-289	Operation of Railroads; Standard Painting, Lettering, and Numbering of Railroad Equipment.
TM 55-290	Operation of Railroads Railway Car Mechanics.

3. Army Regulations

AR 55-650
AR 345-200

Transportation and Travel—Railroads.
Records Administration.

4. Special Regulations

SR 310-30-15

Military Publications Organization and
Equipment Authorization Tables—Per-
sonnel.

5. Tables of Organization and Equipment

TOE 29-500R

Composite Service Organization.

TOE 55-201R

General Headquarters, Transportation
Military Railway Service.

TOE 55-202R

Headquarters and Headquarters Company
Transportation Railway Group.

TOE 55-217R

Transportation Electric Power Transmis-
sion Company.

TOE 55-225R

Transportation Railway Operating Bat-
talion.

TOE 55-226

Headquarters and Headquarters Company
Transportation Railway Operating Bat-
talion.

TOE 55-227R

Railway Engineering Company Transpor-
tation Railway Operating Battalion.

TOE 55-228R

Railway Equipment Company Transpor-
tation Railway Operating Battalion.

TOE 55-229

Train Operating Company Transportation
Railway Operating Battalion.

TOE 55-235R

Transportation Railway Shop Battalion.

TOE 55-236R

Headquarters and Headquarters Company
Transportation Railway Shop Battalion.

TOE 55-237R

Transportation Erecting and Machine
Shop Company.

TOE 55-238R

Transportation Boiler and Smith Shop
Company.

TOE 55-239R

Transportation Car Repair Company.

TOE 55-247R

Transportation Diesel-Electric Locomotive
Repair Company.

TOE 55-260R

Transportation Depot Company.

TOE 55-500R

Transportation Service Organization.

6. Forms and Pamphlets

DA Form 55-223

Conductor's Wheel Reports.

DA Form 55-224

Freight Waybills.

WD Pamphlet 55-1

Safety Rules, Military Railway Service,
U. S. Army.

APPENDIX II

ILLUSTRATIVE EXAMPLE—RAILWAY PLANNING

Situation

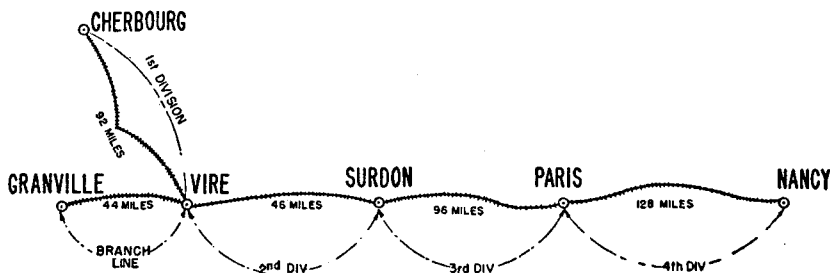


Figure 18. Diagram of situation.

1. It has been indicated that the total tonnage capacity of the branch line Granville-Vire will be utilized for port clearance to depots in the Vire area. Tonnage originating at Cherbourg will be routed over the main line for delivery at the army depots in the vicinity of Nancy.
2. Tons as used in this example are short tons.
3. All computations resulting in a fraction are raised to the next higher whole number.

Intelligence data

Gage	-----	4 ft 8½ in. (standard)
Track	-----	Single; condition, good to fair
Ruling grade	-----	1.4 percent on main line, Cherbourg-Nancy 1.6 percent on branch line, Granville-Vire
Ruling curve	-----	10° on main line, Cherbourg-Nancy 12° on branch line, Granville-Vire
Weather	-----	Wet weather is local and temporary +60° to +92° F. in summer +40° to -5° F. in winter
Passing tracks	-----	7 Cherbourg-Vire 5 Granville-Vire 2 Vire-Surdon 7 Surdon-Paris 10 Paris-Nancy
Motive power	-----	Road engines: foreign 2-8-0, coal-burning, steam. 144 tons—total weight 70 tons—weight on drivers 55 pounds—estimated rate of fuel consumption per train mile. Switch engines: U. S. Army 0-4-4-0, 60-ton, 400-horsepower diesel-electric.
Rolling stock	-----	Foreign 20-ton capacity boxcars Foreign 20-ton capacity gondolas Foreign 30-ton capacity flatcars
Operating personnel	-----	Transportation military railway service personnel (phase I)

FIRST REQUIREMENT

Determine the capacity of the main line, Cherbourg-Nancy, in terms of end delivery tonnage, during the winter months and using single engine operation.

SOLUTION

1. Tractive effort (TE) of road engines (par. 135b).

$$TE = \frac{\text{weight on drivers}}{4} = \frac{140,000 \text{ lb}}{4} \quad (70 \text{ tons}) = 35,000 \text{ lb.}$$

2. Drawbar pull (DBP) of road engines (par. 136).

$$\begin{aligned} DBP &= TE - (\text{weight of engine in tons} \times 20) \\ &= 35,000 - (144 \times 20) \\ &= 35,000 - 2,880 = 32,120 \text{ lb.} \end{aligned}$$

3. Gross trailing load (GTL) (par. 141).

$$GTL = \frac{DBP \times W}{RR + GR + CR} \quad .$$

$$DBP = 32,120 \text{ lb}$$

$$W = 85 \text{ percent (par. 140; table III, app. III)}$$

$$RR = 6 \text{ (par. 137; table II, app. III)}$$

$$GR = 1.4 \times 20 = 28 \text{ (par. 138)}$$

$$CR = 0.8 \times 10 = 8 \text{ (par. 139)}$$

$$GTL = \frac{32,120 \times 0.85}{6 + 28 + 8} = \frac{27,302}{42} = 650 + \text{ or } 651 \text{ tons.}$$

4. Net train load (NTL) (par. 142).

$$NTL = \frac{GTL}{2} = \frac{651}{2} = 325 + \text{ or } 326 \text{ tons.}$$

5. Train density (TD) (par. 143).

$$TD = \frac{NT + 1}{2} \times \frac{24 \times S}{LD}$$

$$S = 10 \text{ mph (table IV, app. III)}$$

$$TD \text{ (1st Div)} = \frac{7 + 1}{2} \times \frac{24 \times 10}{92} = \frac{8}{2} \times \frac{240}{92} = \frac{1920}{184} = 10 + \text{ or } 11$$

$$TD \text{ (2d Div)} = \frac{3 + 1}{2} \times \frac{24 \times 10}{46} = \frac{4}{2} \times \frac{240}{46} = \frac{960}{92} = 10 + \text{ or } 11$$

$$TD \text{ (3d Div)} = \frac{7 + 1}{2} \times \frac{24 \times 10}{96} = \frac{8}{2} \times \frac{240}{96} = \frac{1920}{192} = 10$$

$$TD \text{ (4th Div)} = \frac{10 + 1}{2} \times \frac{24 \times 10}{128} = \frac{11}{2} \times \frac{240}{128} = \frac{2640}{256} = 10 + \text{ or } 11$$

6. Net division tonnage (*NDT*) (par. 144).

$$NDT = TD \times NTL$$

$$NDT \text{ (1st Div)} = 11 \times 326 = 3,586 \text{ tons}$$

$$NDT \text{ (2d Div)} = 11 \times 326 = 3,586 \text{ tons}$$

$$NDT \text{ (3d Div)} = 10 \times 326 = 3,260 \text{ tons}$$

$$NDT \text{ (4th Div)} = 11 \times 326 = 3,586 \text{ tons.}$$

7. End delivery tonnage (*EDT*) (par. 145).

$$EDT = 3,260 \text{ tons (} NDT \text{ of 3d Div).}$$

SECOND REQUIREMENT

Determine the capacity of the branch line, Granville-Vire, in terms of end delivery tonnage for port clearance, during the winter months and using single engine operation.

SOLUTION

1. Gross trailing load (*GTL*) (par. 141).

$$GTL = \frac{DBP \times W}{RR + GR + CR}$$

$$DBP = 32,120 \text{ lb (first requirement)}$$

$$W = 85 \text{ percent (par. 140; table III, app. III)}$$

$$RR = 6 \text{ (par. 137; table II, app. III)}$$

$$GR = 1.6 \times 20 = 32 \text{ (par. 138)}$$

$$CR = 0.8 \times 12 = 9.6 \text{ or } 10 \text{ (par. 139)}$$

$$GTL = \frac{32,120 \times 0.85}{6 + 32 + 10} = \frac{27,302}{48} = 568 + \text{ or } 569 \text{ tons.}$$

2. Net train load (*NTL*) (par. 142).

$$NTL = \frac{GTL}{2} = \frac{569}{2} = 284 + \text{ or } 285 \text{ tons.}$$

3. Train Density (*TD*) (par. 143).

$$TD = \frac{NT + 1}{2} \times \frac{24 \times S}{LD}$$

$S = 8 \text{ mph (table IV, app. III; grade is most restrictive factor)}$

$$TD = \frac{5 + 1}{2} \times \frac{24 \times 8}{44} = \frac{6}{2} \times \frac{192}{44} = \frac{1152}{88} = 13 + \text{ or } 14.$$

4. Net division tonnage (*NDT*) (par. 144).

$$NDT = TD \times NTL$$

$$= 14 \times 285 = 3,990 \text{ tons.}$$

5. End delivery tonnage (*EDT*) (par. 145). Since only one division is involved, the *EDT* is the same as the *NDT*, or 3,990 tons.

THIRD REQUIREMENT

Based upon previous requirements, determine the railway equipment (rolling stock, road engines, and switch engines) requirements for the operation of this rail net.

SOLUTION

1. *Rolling stock* (par. 152).

Compute the requirements for each type of freight car on the following basis:

50 percent of the *NTL* will be shipped in boxcars.

40 per cent of the *NTL* will be shipped in gondolas.

10 percent of the *NTL* will be shipped in flatcars.

a. *Main line operations*

NTL = 326 tons (first requirement)

$326 \times .50 = 163$ tons per train in boxcars

$326 \times .40 = 130 +$ or 131 tons per train in gondolas

$326 \times .10 = 32 +$ or 33 tons per train in flatcars

20 tons = capacity of boxcars; 20 or 10 tons = average payload

2

20 tons = capacity of gondolas; 20 or 10 tons = average payload

2

30 tons = capacity of flatcars; 30 or 15 tons = average payload

2

$163 = 16 +$ or 17 boxcars per train

10

$131 = 13 +$ or 14 gondolas per train

10

$33 = 2 +$ or 3 flatcars per train

15

TD of 1st Div = 11

$11 \times 17 = 187$ boxcars for 1 day's dispatch

$11 \times 14 = 154$ gondolas for 1 day's dispatch

$11 \times 3 = 33$ flatcars for 1 day's dispatch

374 total cars for 1 day's dispatch

(Table VI, app. III)

	Boxcars	Gondolas	Flatcars
Base of operations -----	$2 \times 187 = 374$	$2 \times 154 = 308$	$2 \times 33 = 66$
Forward traffic -----	$4 \times 187 = 748$	$4 \times 154 = 616$	$4 \times 33 = 132$
Return traffic -----	$4 \times 187 = 748$	$4 \times 154 = 616$	$4 \times 33 = 132$
Railhead -----	$2 \times 187 = 374$	$2 \times 154 = 308$	$2 \times 33 = 66$
Totals -----	<u>2,244</u>	<u>1,848</u>	<u>396</u>

b. Branch line operations.

$NTL=285$ tons

$285 \times .50 = 142 +$ or 143 tons per train in boxcars

$285 \times .40 = 114$ tons per train in gondolas

$285 \times .10 = 28 +$ or 29 tons per train in flatcars

$143 = 14 +$ or 15 boxcars per train

10

$114 = 11 +$ or 12 gondolas per train

10

$29 = 1 +$ or 2 flatcars per train

15

$TD=14$

$14 \times 15 = 210$ boxcars for 1 day's dispatch

$14 \times 12 = 168$ gondolas for 1 day's dispatch

$14 \times 2 = 28$ flatcars for 1 day's dispatch

406 total cars for 1 day's dispatch

(Table VI, app. II)

	Boxcars	Gondolas	Flatcars
Base of operations -----	$2 \times 210 = 420$	$2 \times 168 = 336$	$2 \times 28 = 56$
Forward traffic -----	$1 \times 210 = 210$	$1 \times 168 = 168$	$1 \times 28 = 28$
Return traffic -----	$1 \times 210 = 210$	$1 \times 168 = 168$	$1 \times 28 = 28$
Railhead -----	$2 \times 210 = 420$	$2 \times 168 = 336$	$2 \times 28 = 56$
Totals -----	1,260	1,008	168

c. Total rolling stock requirements.

	Boxcars	Gondolas	Flatcars
Main line -----	2,244	1,848	396
Branch line -----	1,260	1,008	168
Subtotal -----	3,504	2,856	564
Plus 10 percent reserve ----	351	286	57
Totals -----	3,855	3,142	621
	3,142		
	621		
Total cars -----	7,618		

2. Road engines (par. 153).

Division	TD	LD	Average speed	RT	TT
1st	11	92 mi	÷ 10 mph	9.2 hr	3 hr
2d	11	46 mi	÷ 10 mph	4.6 hr	3 hr
3d	10	96 mi	÷ 10 mph	9.6 hr	3 hr
4th	11	128 mi	÷ 10 mph	12.8 hr	3 hr
Branch line	14	44 mi	÷ 8 mph	5.5 hr	3 hr

1st Div $= 11 \times (9.2 + 3) \times 2 \times 1.20 = 322.08 = 13 +$ or 14 road engines

2d Div	$=11 \times \frac{(4.6+3)}{24} \times 2 \times 1.20 = 200.64 = 8 +$	or 9 road en-
	gines	
3d Div	$=10 \times \frac{(9.6+3)}{24} \times 2 \times 1.20 = 302.4 = 12 +$	or 13 road en-
	gines	
4th Div	$=11 \times \frac{(12.8+3)}{24} \times 2 \times 1.20 = 417.12 = 17 +$	or 18 road
	engines	
Branch line	$=14 \times \frac{(5.5+3)}{24} \times 2 \times 1.20 = 285.6 = 11 +$	or 12 road en-
	gines	
Total.....		66 road engines

3. Switch engines (par. 154).

374 cars=1 day's dispatch, main line

406 cars=1 day's dispatch, branch line

(See table VI, app. III, for disposition of rolling stock.)

(See table VIII, app. III, for disposition of switch engines.)

Location	Cars dispatched and received per day	Cars passing per day	Computation factor	Switch engines
Cherbourg	2×374		$\div 67$	11+ or 12
Granville	2×406		$\div 67$	12+ or 13
Vire (main line traffic)		2×374	$\div 100$	7+ or 8
Vire (port clearance traffic)	2×406		$\div 67$	12+ or 13
Surdon		2×374	$\div 100$	7+ or 8
Paris		2×374	$\div 100$	7+ or 8
Nancy	2×374		$\div 67$	11+ or 12
		Subtotal		74
		Plus 20 percent reserve		15
		(14+ or 15)		
		Total switch engines		89

FOURTH REQUIREMENT

Based upon previous requirements, determine the personnel requirements for the operation of this rail net. First, determine the traincrew requirements, then on the basis of traincrew requirements, determine the operating, maintenance, and supervisory units of the transportation military railway service required for the overall operation.

SOLUTION

1. Road crews (par. 156).

Division	TD	LD		Average speed	RT
1st	11	92 mi	÷	10 mph	9.2 hr
2d	11	46 mi	÷	10 mph	4.6 hr
3d	10	96 mi	÷	10 mph	9.6 hr
4th	11	128 mi	÷	10 mph	12.8 hr
Branch line	14	44 mi	÷	8 mph	5.5 hr

$$\text{Number of road crews} = \text{TD} \times 2 \times \text{RT} + 3 \times 1.25$$

$$\text{1st Div} = 11 \times 2 \times \frac{9.2}{12} + 3 \times \frac{1.25}{12} = \frac{335.5}{12} = 27 + \frac{12}{12} \text{ or 28 road crews}$$

$$\text{2d Div} = 11 \times 2 \times \frac{4.6}{12} + 3 \times \frac{1.25}{12} = \frac{209}{12} = 17 + \frac{5}{12} \text{ or 18 road crews}$$

$$\text{3d Div} = 10 \times 2 \times \frac{9.6}{12} + 3 \times \frac{1.25}{12} = \frac{315}{12} = 26 + \frac{3}{12} \text{ or 27 road crews}$$

$$\text{4th Div} = 11 \times 2 \times \frac{12.8}{12} + 3 \times \frac{1.25}{12} = \frac{434.5}{12} = 36 + \frac{2}{12} \text{ or 37 road crews}$$

$$\text{Branch line} = 14 \times 2 \times \frac{5.5}{12} + 3 \times \frac{1.25}{12} = \frac{297.5}{12} = 24 + \frac{3}{12} \text{ or 25 road crews}$$

$$\text{Total} = \dots\dots\dots 135 \text{ road crews}$$

2. Switch crews (par. 157).

$$\text{Number of switch crews} = \text{No. of switch engines} \times 2 + 1.25$$

Note. Do not compute switch crews for reserve engines.

Cherbourg	$= 12 \times 2 \times 1.25 =$	30 switch crews
Granville	$= 13 \times 2 \times 1.25 = 32 +$ or	33 switch crews
Vire	$= 21 \times 2 \times 1.25 = 52 +$ or	53 switch crews
Surdon	$= 8 \times 2 \times 1.25 =$	20 switch crews
Paris	$= 8 \times 2 \times 1.25 =$	20 switch crews
Nancy	$= 12 \times 2 \times 1.25 =$	30 switch crews
Total		<u>186 switch crews</u>

3. Total Crews.

135 road crews

186 switch crews

321 total crews

4. *Railway unit requirements* (par. 158) (fig. 11).

a. *Railway operating battalions.*

321 (total crews) = 6 battalions plus 21 crews

(50 crews per battalion) from TOE 55-500R

The 6 battalions could be assigned as follows:

	<i>Terminal</i>	<i>Road</i>
1st Bn	Cherbourg	Cherbourg-Vire
2d Bn	Granville	Granville-Vire
3d Bn	Vire	None
4th Bn	Surdon	Vire-Surdon
5th Bn	Paris	Surdon-Paris
6th Bn	Nancy	Paris-Nancy

b. *Railway shop battalions.*

2 battalions required (1 per 2 to 4 operating battalions).

c. *Railway groups.*

1 group required (1 per 2 to 6 operating battalions).

d. *Railway commands.*

None required (1 per 2 or more groups).

e. *General headquarters, transportation military railway service.*

None required (1 per 2 or more commands).

f. *Railway workshops (mobile).*

1 required (1 per group).

a. *Transportation depot companies.*

None required (1 per command).

FIFTH REQUIREMENT

Based upon previous requirements, determine the amount of fuel required per month for the operation of this line.

SOLUTION

1. *Road engines* (par. 160).

<i>Division</i>	<i>TD</i>	<i>Two-way travel</i>		<i>LD</i>	<i>Train miles per day</i>	
1st	11 ×	2	×	92 mi	=	2,024
2d	11 ×	2	×	46 mi	=	1,012
3d	10 ×	2	×	96 mi	=	1,920
4th	11 ×	2	×	128 mi	=	2,816
Branch line	14 ×	2	×	44 mi	=	1,232
Total train miles						9,004

$9,004 \times 55$ (pounds coal per train mile) = 495,220 pounds of coal per day

$495,200 \div 2,000 = 247 +$ or 248 tons of coal per day

$248 \times 30 = 7,440$ tons of coal per month

Add 10 percent for contingencies: $7,440 + 744 = 8,184$ tons of coal required per month for road engines.

2. *Switch engines* (par. 160).

74=total number switch engines (not including reserve)

20=number of hours per day each engine is in operation

4=number of gallons of fuel consumed per hour in switching
(table IX, app. III)

$74 \times 20 \times 4 = 5,920$ gallons per day

$5,920 \times 30 = 177,600$ gallons per month

Add 5 percent for contingencies: $177,600 + 8,880 = 186,480$ gallons
of diesel oil required per month for switch engines.

SIXTH REQUIREMENT

Based upon previous requirements determine the amounts of lubricants and spare parts required per month for the operation of this line.

SOLUTION

1. *Lubricants* (par. 161).

<i>Division</i>	<i>TD</i>	<i>Two-way travel</i>		<i>Pounds per month per train per day</i>	<i>Pounds per month</i>
1st	11 ×	2	×	1,000	= 22,000
2d	11 ×	2	×	1,000	= 22,000
3d	10 ×	2	×	1,000	= 20,000
4th	11 ×	2	×	1,000	= 22,000
Branch line	14 ×	2	×	1,000	= 28,000
Total					114,000

2. *Spare parts* (par. 162).

<i>Division</i>	<i>TD</i>	<i>Two-way travel</i>		<i>Tons per month per train per day</i>	<i>Tons per month</i>
1st	11 ×	2	×	1.5	= 33
2d	11 ×	2	×	1.5	= 33
3d	10 ×	2	×	1.5	= 30
4th	11 ×	2	×	1.5	= 33
Branch line	14 ×	2	×	1.5	= 42
Total					171

APPENDIX III

STATISTICS

Table I. Characteristics of United States Army Locomotives

Type of locomotive	Weight on drivers (S/T)	Starting TE (lb)	Total weight (S/T)	Maximum curvature traversible (degrees)
Standard-to-broad gage (56½ in., 60-in., 68-in., and 66-in. gage).				
0-6-6-0, diesel-electric, 120-ton, 1600-horsepower, road-switcher.	120	72,000	120	30
0-4-4-0, diesel-electric, 60-ton, 400-horsepower, road-switcher.	60	36,200	60	76
2-8-0, steam, 82-ton, road-----	70	34,100	144	25
Narrow gage (36-in., 39¾-in., and 42-in. gage).				
0-6-6-0, diesel-electric, 80-ton, 1,000 horsepower, road-switcher. (This locomotive is under development; data is estimated.)	80	48,000	80	40
0-4-4-0, diesel-electric, 60-ton, 400-horsepower, road-switcher.	60	35,250	60	76
2-8-2, steam, 60-ton, road-----	40	20,100	110	25

Note. The starting TE given in this table may also be used as the continuous tractive effort for steam power. For diesel-electric power, the continuous TE is one-half of the starting TE.

Table II. Average Values of Rolling Resistance

Pounds per ton of train	Condition of track
5	Exceptionally good.
6	Good to fair.
7	Fair to poor.
8	Poor.
9 and 10	Very poor.

Table III. Effect of Weather Upon Hauling Power of Locomotives

Most adverse temperature in °F.	Loss in hauling power (percent)	Weather factor (percent)
Above +32 -----	0	100
+16 to +32 -----	5	95
0 to +15 -----	10	90
-1 to -10 -----	15	85
-11 to -20 -----	20	80
-21 to -25 -----	25	75
-26 to -30 -----	30	70
-31 to -35 -----	35	65
-36 to -40 -----	40	60
-41 to -45 -----	45	55
-46 to -50 -----	50	50

Table IV. Determining Average Speed Values

Condition of track	Percent of grade	Average speed	
		Single track	Double track
Exceptionally good -----	1 percent or less -----	12 mph	14 mph
Good to fair -----	1.5 percent or less -----	10 mph	12 mph
Fair to poor -----	2.5 percent or less -----	8 mph	10 mph
Poor -----	3 percent or less -----	6 mph	8 mph

A. The most restrictive factor governs the speed selected.

B. In using the table for average speed factor, consider the following:

1. If the condition of track and/or the percent of grade is not known, use an average speed value of 8 mph for single track and 10 mph for double track.

2. Where the more restrictive factor occurs for a comparatively short distance, that is, less than 10 percent of the division, use the next higher average speed (par. 4 below).

3. Where average speed falls below 6 mph because of the gradient, reduce the tonnage to increase speed. (Two percent reduction in gross tonnage will increase speed 1 mile per hour).

4. If the ruling grade materially affects the tonnage, consider using helper service.

Table V. Characteristics of Rolling Stock

	Capacity (S/T)	Weight empty (S/T)	Inside dimensions		
			Length	Width	Height
<i>Standard-to-broad gage</i> (56½-in., 60-in., 63-in., and 66-in. gage).					
Boxcar -----	40	18	40-ft 6-in.	8-ft 6-in.	7-ft 11-in.
Gondola—low side.	40	15.2	40-ft 4½-in.	8-ft 3¼-in.	1-ft 6-in.
Gondola—high side.	40	17.7	40-ft 5½-in.	8-ft 3¾-in.	5-ft
Flatcar—regular	40	14.4	40-ft 9-in.	8-ft 7¼-in.	-----
Flatcar—heavy duty.	80	35.5	46-ft 8-in.	9-ft 8-in.	-----
Refrigerator car	40	19	40-ft 6-in.	8-ft 6-in.	6-ft 9¾-in.
Tank car -----	10,000 (gal).	20	38-ft 5¾-in.	8-ft ¾-in. (diam.).	-----
<i>Narrow gage</i> (36-in., 39¾-in., and 42-in. gage).					
Boxcar -----	30	13.6	34-ft 5½-in.	7-ft ¾-in.	6-ft 1¾-in.
Gondola—low side.	30	12.1	34-ft 6-in.	6-ft 10½-in.	1-ft 6-in.
Gondola—high side.	30	13.3	34-ft 5-in.	6-ft 10½-in.	4-ft
Flatcar -----	30	11.0	34-ft 8½-in.	7-ft 2-in.	-----
Refrigerator car	30	16.5	31-ft ½-in.	6-ft 6¼-in.	6-ft 3½-in.
Tank car -----	5,000 (gal).	17.5	31-ft 5-in.	5-ft 3¼-in.	-----

Table VI. Disposition of Rolling Stock

Disposition	Rolling stock required
At base of operation -----	2 days' dispatch.
Forward traffic -----	1 day's dispatch per division.
Return traffic -----	1 day's dispatch per division.
At the railhead -----	2 days' dispatch.

Table VII. Terminal Time Average Values

Type of motive power	Hours
Steam-powered -----	8
Diesel-electric -----	3

Table VIII. Disposition of Switch Engines

Location	Switch engines required
Port or loading terminals-----	1 per 67 cars dispatched and received per day.
Division terminals -----	1 per 100 cars passing per day.
Railhead or unloading terminals-----	1 per 67 cars dispatched and received per day.

Table IX. Fuel Requirements for Locomotives

Type of locomotive	Estimated rate of fuel consumption	
	Road per train mile	Switching per hour
<i>Standard-to-broad gage (56½-in., 60-in., 63-in., and 66-in. gage).</i>		
0-6-6-0, diesel-electric, 120-ton, 1600-horsepower	2.5 gal.	7.5 gal.
0-4-4-0, diesel-electric, 60-ton, 400-horsepower--	.9 gal.	4.0 gal.
2-8-0, steam, 82-ton, coal-burning-----	90.0 lb.	700.0 lb.
2-8-0, steam, 82-ton, oil burning-----	55.0 lb.	450.0 lb.
<i>Narrow gage (36-in., 39¾-in., and 42-in. gage).</i>		
0-6-6-0, diesel-electric, 80-ton, 1,000-horsepower. (This locomotive is under development; data is estimated.)	1.5 gal.	6.0 gal.
0-4-4-0, diesel-electric, 48-ton, 400-horsepower--	.9 gal.	4.0 gal.
2-8-2, steam, 60-ton, coal-burning-----	100.0 lb.	750.0 lb.
2-8-2, steam, 60-ton, oil burning-----	60.0 lb.	500.0 lb.

TABLE X.—Bridge Capacities Expressed in Cooper's E Rating as Reflected in the Dimensions of Stringers or Open Deck Girder Bridges of Various Span Lengths

Span length (feet)		10	11	12	13	14	15	16	17	18	19	20	22	24	26
Stringer dimensions (inches)															
Lower Flange															
Thickness	Width	Stringer depth													
3/8	8 3/8	E-42	E-41	E-41	E-41										
3/8	10 3/8		E-59	E-48	E-40	E-35	E-31	E-27							
1/2	10 3/8				E-61	E-59	E-51	E-46	E-41	E-37	E-33	E-30	E-27		
1/2	12 1/2						E-62	E-56	E-50	E-45	E-41	E-37	E-31	E-26	
1	14								E-60	E-58	E-55	E-54	E-51	E-48	E-43
1/2	12 3/8										E-60	E-54	E-45	E-39	E-34
1 1/8	14											E-53	E-60	E-57	E-54

Span length (feet)		28	30	35	40	44	50	54	60	64	70	74	80	84	90
Stringer dimensions (inches)															
1	14	E-59	E-34	E-26											
1 1/2	12 3/8	E-30	E-26												
1 1/8	14	E-51	E-45												
1 1/8	16	E-60	E-54	E-42	E-32										
1 1/2	16		E-57	E-52	E-47	E-43	E-33								
1	16	E-66	E-59	E-45	E-35	E-30									
1 1/8	14			E-54	E-43	E-36	E-28								
1 3/4	14				E-60	E-54	E-43	E-37	E-30	E-27					
1 1/2	14				E-57	E-48	E-38	E-33	E-27						
2 1/8	15						E-57	E-54	E-46	E-41	E-34	E-31	E-26		
2	14						E-56	E-48	E-40	E-35	E-30	E-26			
2	14						E-62	E-54	E-44	E-39	E-32	E-29	E-25		
2 1/2	15 1/2								E-55	E-51	E-43	E-38	E-33	E-29	
2 1/8	14								E-52	E-46	E-39	E-35	E-30		
2 1/2	16							E-64	E-52	E-64	E-54	E-49	E-41	E-38	E-30
2 11/16	20													E-59	E-51

TABLE XI. Bridge Capacities Expressed in Cooper's E Rating as Reflected in the Dimensions of Rectangular Wooden Stringers

Span length (feet) Stringer dimensions (inches)		10	12	14	16	18	20	22
Width	Depth							
18	12	E-16	E-12	.....	.....	.....	.....	.....
18	14	E-22	E-18	E-10	.....	.....	.....	.....
18	16	E-28	E-20	E-15	E-10	.....	.....	.....
18	18	E-38	E-26	E-18	E-14	E-12	.....	.....
20	12	E-18	E-12	.....	.....	.....	.....	.....
20	14	E-25	E-17	E-12	.....	.....	.....	.....
20	16	E-33	E-23	E-16	E-12	E-10	.....	.....
20	18	E-43	E-29	E-21	E-16	E-13	E-10	.....
24	12	E-22	E-15	E-11	.....	.....	.....	.....
24	14	E-30	E-21	E-14	E-11	.....	.....	.....
24	16	E-40	E-28	E-20	E-15	E-12	.....	.....
24	18	E-52	E-36	E-25	E-19	E-15	E-12	E-10
36	12	E-34	E-23	E-17	E-12	E-10	.....	.....
36	14	E-47	E-32	E-23	E-17	E-14	E-11	.....
36	16	E-62	E-43	E-30	E-23	E-19	E-15	.....
36	18	E-78	E-53	E-39	E-30	E-24	E-20	E-16
40	12	E-38	E-26	E-19	E-14	E-11	.....	.....
40	14	E-52	E-36	E-26	E-20	E-16	E-12	.....
40	16	E-69	E-47	E-35	E-26	E-21	E-17	.....
40	18	E-87	E-60	E-44	E-34	E-27	E-22	E-18
48	12	E-46	E-31	E-23	E-17	E-13	.....	.....
48	14	E-63	E-43	E-31	E-24	E-19	E-15	.....
48	16	E-83	E-57	E-41	E-32	E-26	E-21	.....
48	18	E-105	E-73	E-53	E-41	E-33	E-27	E-22
54	12	E-52	E-35	E-27	E-19	E-15	.....	.....
54	14	E-72	E-49	E-35	E-27	E-22	E-18	.....
54	16	E-94	E-65	E-46	E-36	E-29	E-24	.....
54	18	E-119	E-82	E-60	E-46	E-38	E-30	E-25
60	12	E-58	E-40	E-30	E-22	E-17	.....	.....
60	14	E-79	E-55	E-39	E-30	E-25	E-20	.....
60	16	E-104	E-72	E-52	E-40	E-38	E-27	.....
60	18	E-132	E-92	E-67	E-52	E-42	E-34	E-28

Note. In computing loading for bridges of wooden stringer construction, use the total width of all stringers under one track and the depth of one stringer.

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BY ORDER OF THE SECRETARY OF THE ARMY:

MAXWELL D. TAYLOR,
General, United States Army,
Chief of Staff.

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OS Maj Comd (5)	Units organized under following TOE:
OS Base Comd (2)	55-201R, GHQ, Trans Ry Svc (5)
Log Comd (2)	55-202R, Hq & Hq Co, Trans Ry Gp (5)
MDW (2)	55-217R, Trans Elec Power Xmsn Co (5)
Armies (2)	55-225R, Trans Ry Opr Bn (5)
Ft & Cp (2)	55-235R, Trans Ry Shop Bn (5)
USMA (2)	55-302R, Hq & Hq Co, Trans Ry Comd (5)

NG: State AG (6); Units—Same as Active Army.

USAR: Same as Active Army.

For explanation of abbreviations used, see SR 320-50-1.